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NOTES AND COMMENTS.

A National Trust for Places of Beauty and Interest.

WE learn from the *Daily News* that a movement which may turn out to be of some importance was started at the rooms of the Commons Preservation Society on November 16. It has long been felt that the nation is in the way of losing some of its most valuable possessions through the want of some custodian to whom they may be readily transferred, and by whom they will be jealously guarded. Districts celebrated for their natural beauty are by degrees marred and disfigured; houses and ruins of unique interest are destroyed, because, passing from hand to hand, they some day come into the ownership of persons unable to appreciate them, or forced to realise any money value they may have. Within the last two years, such noteworthy spots as the top of Snowdon, the island in the middle of Grasmere Lake, and the Lodore Falls have come into the market, and might not improbably have been permanently secured for the public enjoyment had some body capable of acquiring and protecting them in the public interest been in existence. We have also noticed with grief the quarrying operations that are carried on along the Cheddar Cliffs —the grandest inland cliffs in this country—as if there were not abundance of the Mountain Limestone to be obtained elsewhere in the neighbourhood. Local authorities can hardly at present be expected to help the public to preserve the beauty of its great pleasure grounds; their area of action and the sources from which they draw their funds are, as a rule, too contracted, and they have many claims upon their not too ample resources. But apart from local authority there is absolutely no body which can hold and manage places of beauty and interest on behalf of the public; for the existing open space societies are not corporate bodies and exist rather to influence public opinion than to hold property. This want it is now proposed to meet. Canon Rawnsley, the Vicar of Keswick,

well known as an energetic champion of the Lake District, has for some weeks been enlisting support for a body which it is proposed to style the "National Trust for Places of Historic Interest and Natural Beauty." This body is to be incorporated under the Joint Stock Companies Acts, with the licence of the Board of Trade, as a non-profit-earning society. Its primary function will be to accept from landowners gifts of places which they desire to place beyond risk of injury from their successors, and to keep such places intact and at the service of the nation. As funds increase it is thought that purchases of important places may be made, either at the expense of the general agents of the society, or by means of special contributions for the purpose. The new society is enabled to make a beginning by the generosity of a Welsh landowner, who is desirous of transferring to its care a beautiful sea-cliff on the West Coast. It numbers among its adherents such well-known names as the Duke of Westminster, Lord Dufferin, Lord Rosebery, Sir Frederick Leighton, Professor Huxley, the Master of Trinity, Cambridge, Mr. Shaw Lefevre, and Miss Octavia Hill, and will lose no time in "acquiring legal form, and entering upon its duties." In so doing it will certainly carry with it the good wishes of all who have a feeling for nature and historic association.

WINCHESTER COLLEGE.

ALL the world knows that Winchester College has recently been celebrating its Quingentenary. To commemorate this event by some permanent memorial has long been the wish of Wykehamists; but the multiplicity of proposals proved the truth of the saying, "quot homines, tot sententiæ." It has at last been decided to raise a fund for two purposes. First, the restoration of William of Wykeham's Chantry in Winchester Cathedral; secondly, the establishment of "a group of Memorial Buildings for the preservation of Wykehamical antiquities, and the encouragement of art, archæology, natural history, and other sciences."

The former of these objects lies outside our province. With regard to the latter, we extract from the circular of the Executive Committee the following excellent remarks :—

"The aims of the collection of archæology and art would be (i.) to illustrate and encourage the regular course of school study; (ii.) to furnish boys with interests outside that regular course. The first division would naturally consist mainly of collections illustrating classical art, or otherwise bearing on the study of the classics or the Bible. The second division would consist mainly of mediæval or modern specimens of art. Such collections would consist of representative series of reproductions of objects of art selected for their beauty or educational value, and of any good originals that could be obtained. The latter are needed to give reality to the collection,

and to let boys acquire a touch-and-handle familiarity with specimens; the former to show the real beauty of antiquities, and to stimulate a desire to visit the famous collections."

"The science collections would probably be a development in more adequate quarters of the present collection of the Natural History Society, which is good though not large. Special stress would doubtless be laid on the collection of local minerals [fossils are doubtless meant], fauna, and flora. An attempt might also be made (as has been done at Harrow) to imitate the admirably instructive series of type forms exhibited in the Museum of Natural History at South Kensington; and it would be highly desirable to connect some moderate provision for elementary biological and botanical work with the natural history museum."

"It would be premature at present to venture on more than the most general sketch, but many other developments might be suggested which should be the work of subsequent years, for it must always be borne in mind that for the purposes of a school museum the process of growth is more valuable than any completed collection, and that the undertaking will be a failure unless it commands the sustained interest and support of masters and boys alike."

All who sympathise with the extension of scientific education will rejoice that Winchester is no longer to be behind our other great Public Schools in this respect; and if we number any Wykehamists among our readers, we have no doubt that they will hasten to send in their subscriptions to Mr. Percy Toynbee, 109 Gloucester Terrace, Hyde Park. As for the presentation of specimens, we will lead the way with a little bit of advice to the Committee:—Be as ready to refuse as to accept!

The American Association for the Advancement of Science.

We take the following comment from the last number of the *American Naturalist*, and commend it to the notice of those interested in the welfare of the British and kindred Associations:—"The question is often asked, Why do the American zoologists so universally neglect the American Association for the Advancement of Science? For many years scarcely an American publishing zoologist has been present at the meeting, while the few papers on zoological subjects are in striking contrast to the interest shown in the sister science of botany. The reasons for this state of affairs are not readily stated. Possibly most potent of all is the feeling that the Association is far from being a representative of American science, and that it has degenerated into an annual junketing party. It is certain that the interests of science have been often sacrificed to excursions which interrupt the sessions, and which should be postponed to their close. Then, too, criticisms are often heard that it is run as a close corporation, that nominating boards are packed in order that certain persons may be put in office,

and that the expenses of the Association are far greater than they should be for the results achieved. There is, too, an inside history which cannot be detailed, which would explain a large portion of the indifference displayed. Before the Association can regain its influence, it must undergo a complete transformation in its management and methods of administration. It must also present features which will attract the better workers of the country."

Fortunately, the harmony of the British Association is not marred by any such "inside history" as that of which our American cousins complain; but even here, and in other British learned Societies, those who happen to hold professional positions do not always pay that respect to distinguished amateurs which is their due, when chosen to officiate or to inaugurate discussions. The picnic-element can never be entirely eliminated from annual gatherings—it is not desirable that it should be. Science cannot progress satisfactorily without some practical sympathy on the part of the outside public; and it is the duty of those concerned in purely scientific work at the great festival which nearly every civilised nation now holds, to maintain the correct balance between technical discourses and intellectual recreation.

The Correlation of Geological Formations in Europe.

With the advance of science, more and more minute methods of investigation are adopted, methods which could not have been adopted before, while sources of error remained so numerous, but which, when once a firm foundation has been laid for them, speedily lead to important results. It is often found, too, that the foundations are laid by branches of a science that appear distinct, and that the eventual results are attained by the combination of differerent methods. Changes of this kind are now taking place in Palæontology and Stratigraphical Geology. It is no longer possible for the palæontologist to study his fossils within the four walls of a museum. He has learnt all that can be learnt there; but now he sees certain minute differences between forms, which he cannot quite explain. They may be important or they may be only accidental. He can only decide by himself carefully collecting the specimens in the field. Prepared by long study of certain groups of animals, intimately knowing them, almost as a shepherd does his sheep, he now proceeds to examine the rocks with equal minuteness. He is no longer content with the broad generalisations of pioneer geologists, but, just as he has already split up the genera of the old naturalists into numberless more accurately defined new genera and sub-genera, so he must divide the strata into zones and sub-zones and almost infinitesimal horizons. Then at last he will be able to discover the relations that exist between the variations that he has observed in his fossils and their place in geological history, and he will be able to trace out with a certainty that none can gainsay the evolution of species and of genera, and the migrations of fauna.

Work of this kind has been done abroad for some time. The important biological results of Beecher, Clarke, and others, to which we have often alluded (NATURAL SCIENCE, vol. i. pp. 606, 628; vol. iii., pp. 15 and 163), almost entirely depend on very careful collecting, inch by inch, through considerable thicknesses of rock. Munier-Chalmas and Haug have done similar work in Europe of late years; but in England, if we except the admirable investigations of Lapworth on Graptolite zones, which could only have been carried out by a man thoroughly acquainted with the fossils, little of the kind has been accomplished. We therefore welcome heartily the very interesting paper by S. S. Buckman, on the Bajocian of the Sherborne district, just published in the *Quarterly Journal of the Geological Society* (vol. xlix., p. 479). Not only by his exact knowledge of, and previous work on, the Stratigraphy of the Dorset Oolites, but by his prolonged studies of their most important fossils, the Ammonites, he is excellently qualified for work of the kind we have just described. Hence we are not surprised to see that he goes very much further than previous geologists in his subdivision of the strata, while that his subdivisions are not illusory is proved by the possibility of tracing them in adjacent districts and even on the Continent. Thus, he is able to show that there is the same faunal succession in Dorset, Somerset, Gloucestershire, Normandy, Southern France, and Würtemberg. This important point, it must be remembered, could never have been proved under the old system, when three zones were the most that were recognised in the Inferior Oolite. Indeed, as the President of the Geological Society remarked at the reading of the paper, "It was scarcely too much to say that if rocks were to be studied in this minute way, the whole of stratigraphical palæontology would be revolutionised."

The point in Mr. Buckman's paper that will most strike the casual reader is his proposal of a new term, "hemera," as a subdivision of the technical term "age." Practically the word means the time during which a particular species was in existence. Thus "*fuscæ* hemera" means the period of time during which *Oppelia fusca* lived in the district in question. The species chosen to give names to hemeræ are, of course, those that only had a short existence, for the object is "to mark the smallest consecutive divisions which the sequence of different species enables us to separate in the maximum developments of strata." The term, therefore, is a purely chronological one, neither superseding nor a subdivision of "zone," so that the objections to it made by speakers at the meeting fall to the ground. Mr. Buckman, indeed, points out that species actually occurring together in a thin band of rock, may really belong to different hemeræ, a fact which can sometimes be proved by examining the same stratum in another place where its development is greater.

Of the other very interesting results brought out by this detailed method of work, such as the variations in the amount of deposition and the migrations of the mollusca correlated therewith, we can hardly

speak here. It is certainly obvious that this kind of investigation is what we want more of; but it is also obvious that it can only be done by those who, like Mr. Buckman, are palæontological specialists, and who are, like him, intimately acquainted with the district that they are examining, and able to take advantage of every temporary exposure. This is where our numerous local geologists and collectors will find their opportunity.

The Correlation of Geological Formations in America.

The principles alluded to above are clearly not neglected by our fellow-workers on the other side of the Atlantic. The Geological Survey of the United States has issued a series of "Bulletins" during the past few years dealing with the Correlation of the Geological Formations of the United States. These bulletins (nos. 80, 1891, Devonian and Carboniferous; 81, 1891, Cambrian; 82, 1891, Cretaceous; 83, 1891, Eocene; 84, 1892, Neocene; 85, 1892, Newark System; 86, 1892, Archæan and Algonkin) are historical studies of the classifications and nomenclatures of the formations, made for the purpose of ascertaining how satisfactory correlations have been made, and upon what principles they have been based. The literature of the century has been reviewed, and various specific problems have arisen for the solution of which it has been necessary to determine the relations between standard formations already named and classified and those newly discovered. The discussion of each problem has been followed out in detail, the various attempts at correlation have been noted, and the methods employed and the final results attained have been traced to the principles involved in their determination.

We reproduce here the headings of researches dealt with in the Devonian and Carboniferous monograph, as giving a good idea of the amount of material rendered easily available to the geological student. They are as follows:—

(1) The general correlation of the Palæozoic formations of eastern North America with the corresponding formations of Europe.

(2) The determination of the parallelism between the upper Palæozoic formations of the Appalachian region and the rocks of the interior of the continent as far west as the Mississippi River.

(3) The correlation of the northern Appalachian region with the various subdivisions of the Coal-measures and formations immediately underlying them.

(4) The problems connected with the correlation of the Chemung and Catskill groups, and with the correlation of the Waverley and Marshall groups.

(5) The elaboration of the Mississippian series, or "sub-Carboniferous" formations of the Mississippi River basin.

(6) The Permian problems of Kansas and Nebraska.

(7) The correlation problems involved in classifying (*a*) the formations of the Acadian province, and (*b*) the formations of the Rocky Mountains and Western Plateau provinces.

In the discussion of these various problems, the definite stages in the development of the principles of correlation have been recognised.

At the opening of the century, the Wernerian system of classification was adopted. In this classification, the mineral character of the formations was regarded as fundamental.

The second stage took definite shape in the New York system, and while a general "parallelism of strata" was believed in, "gaps" and "intercalations" were assumed, to make the interpretations fit the facts. Fossils played a secondary part, only being considered of value when exact identity was recognised. This principle did not reach satisfactory results, because stratigraphic order and stratification itself offer no intrinsic evidence of the age of a formation, and stratigraphic structure was found not to be uniformly persistent even for a few miles' extent.

William Smith, early in the century, advanced the idea that strata could be identified by the fossils they contained, and we need not trouble the reader with any proofs of the value of this.

Hence in the third stage of the correlations methods, fossils assumed the chief *rôle*, and the minute and exhaustive study of organised beings in their stratigraphical and geological relations has proved to be, not merely the best, but the only reliable guide to correlation of geological formations.

The conclusions reached from these historical studies confirm the belief that the description and nomenclature of structural formations should be quite independent of their correlations, and that precision in correlation must be based upon mature and exhaustive palæontological study, that the time-scale must be made independently of the structure-scale, and that the time-scale of correlation is based fundamentally upon biological data.

The investigations also lead to the further conclusions that, as nomenclature finds its basis in some intrinsic characters of the things named, *uniformity of nomenclature* for formations is impracticable, since the intrinsic characters of formations are local, and have nothing to do with their geological position; and that *uniformity of classification* can be looked for only through an exhaustive biological study of fossils, and is inapplicable to geological structure, stratigraphy, or formation.

When it is mentioned that the Archæan paper occupies 550 closely printed octavo pages, it will be seen that the amount of labour expended on these Reports is prodigious. They are most valuable to the geological student on both sides of the Atlantic, and we regret that space does not allow us to give a detailed account of the several monographs.

GEOLOGICAL SURVEY OF QUEENSLAND.

THE annual progress of the Geological Survey in this vast territory is not to be estimated by the number of square miles mapped; it must be judged by the separate detailed reports on areas of special economic interest. The work, which is under the superintendence of Mr. Robert L. Jack, Government Geologist, is well organised. The headquarters of the Survey have been removed from Townsville to Brisbane, and there is placed the collection of minerals, rocks, and fossils. There the officers, when not engaged in field-duties, are employed in writing reports, in preparing geological maps, in laboratory work, and in affording information to miners and others. Plans of old mines, wherever possible, are preserved. In some cases it is difficult to find out anything about the earlier gold workings; no plans have been kept; and yet, in certain instances, the workings, not rich enough to pay formerly, may be again approached when cheaper processes for treating the ore come into use. A most important work will thus be done by keeping a permanent record of mining operations.

Among the Reports which we have received are the following:—The Kangaroo Hills Silver and Tin Mines, by Mr. Jack; Geological Observations in the Cooktown District, by Mr. W. H. Rands, with accounts of Coal, Gold, Antimony, and Tin; and Grass-tree Gold Field, near Mackay, by Mr. Jack. These Reports and the Maps can now be obtained in London at the Office of the *British Australasian*, 31 Fleet Street.

THE INHERITANCE OF ACQUIRED CHARACTERS.

OWING to their coiling, the shells of Ammonoidea and Nautiloidea have furnished biologists with much evidence bearing on theories of evolution, and now Professor A. Hyatt has discovered yet another point, which, he claims, proves that acquired characters have been inherited (*American Naturalist*, vol. xxvii., p. 865). Coiled Nautiloidea have, as everyone admits, been gradually derived from straight forms, such as *Orthoceras*. The cross-section of an Orthoceran, or even of a slightly-curved Cyrtoceran, or loosely-coiled form, is circular or elliptical; but the section of a close-coiled form, like *Nautilus*, shows an impression of that part which comes in contact with the preceding whorl, so that there is a re-entrant curve. In old age, however, when the shells again uncoil, this impressed zone disappears, and the section becomes circular again, a fact which seems to show that the feature is directly due to pressure, and is, therefore, an acquired character. As such it is not found in the early, uncoiled stages of those Nautiloidea that are close-coiled in the adult; at least, it is not so found in any of the Silurian or Devonian species. But at last, in the Carboniferous, Professor Hyatt has found a species that seems to prove his point; for, in *Coloceras globatum*, which is in many respects a highly-specialised

species, seven specimens examined have shown this impressed zone existing while the shell was still in the partly-curved or cyrtoceran stage. The same early appearance of the impressed zone is likewise seen in numerous Jurassic, Cretaceous, and Tertiary species, including the living *Nautilus pompilius*. This, then, seems due to the inheritance of a character in successively earlier stages of individual development, according to a well-known law; while the character so inherited is believed to be an acquired one.

Nuclear Division.

In the *Annals of Botany* for September (vol. vii., pp. 393–397), Professor J. B. Farmer publishes an interesting preliminary note on nuclear division in the pollen-mother-cells of *Lilium Martagon*. The processes of karyokinesis in animals and plants now are recognised to be so similar as to suggest identity in cause, and zoologists as well as botanists will read this note with interest. It tells of the discovery of multipolar spindles in cell-division. These spindles stand in obvious relation to granules not unlike centrosomes and are placed at their poles, and there is some reason to infer that these granules in the cytoplasm have been derived from the nucleolus. Of course, multipolar spindles have been observed before, both in plants and in animals, and Hertwig and others have asserted a nuclear origin for the centrosome. But the full publication of Mr. Farmer's results will be awaited with interest, as aberrant cases like this frequently call attention to important details obscure in normal types.

The Flora of Eastern Malaya.

The Flora of the Eastern Coast of the Malay Peninsula forms the subject of the latest number of the Linnean Society's *Transactions* (vol. iii., part 9). Mr. H. N. Ridley, during the past few years in which he has held the post of Director of the Gardens and Forest Department, Singapore, has made some collecting trips on the eastern side of the Peninsula, the Flora of which was practically unknown; the researches of the earlier botanists like Griffith, Wallich, and Scortechini, and of the later collectors, having been confined to the more accessible western side. Mr. Ridley collected chiefly in the native State of Pahang, but also visited the more northern States of Kelantan and Tringganu, and the island of Pulau Tiuman, off the coast of Johore. The number of species collected and observed exceeds 1,200, but this represents only a small proportion of the whole flora, as opportunities of collecting were often limited, while many of the trees and shrubs were not in flower or fruit at the time, and did not therefore afford material for identification. It is suggested that three times this number would not be an over-estimate of the species existing in the area traversed. Those obtained give a fair representation of the lowland and coast flora, and of that of the

sub-alpine woods of the Tahan district and of the limestone rocks of Kota Glanggi.

There is a very marked difference between the floras of Singapore and Pahang. Many plants which are common in the southern part of the Peninsula, and especially the secondary jungle plants, become scarce or disappear in Pahang, while there is a large accession of Bornean types. The latter, Mr. Ridley is inclined to regard rather as the relics of an older flora common to the whole of this region, than as forming part of a distinct Bornean flora.

The littoral flora was best seen at the mouth of the Pahang River. Above high-water mark on the sandy sea-shore, was a single row of Casuarinas (*C. equisetifolia*), on the branches of which were many lichens and fungi and a fine orange *Loranthus*, which is described as a new species. The ground beneath was carpeted with many grasses and sedges, Ipomœas, etc. The most striking were the porcupine-grass (*Spinifex squarrosus*) and a beautiful prostrate, blue-flowered *Vitex*. The mangrove-swamps proved less extensive than in most parts of the Peninsula, as, owing to the sandy character of the country, the rivers do not bring down the requisite mud.

Passing up the river towards the capital, Pekan, one enters a great heath district, consisting of flat, open, sandy country, dotted over with thickets and clumps of bushes, alternating with grassy patches. Here were found many interesting grasses and sedges, and among the bushes or trees Eugenias, *Ilex*, several figs, and, growing upon them, many ferns and Loranths, and some small orchids. On the right bank of the river at Pekan, the country is more swampy and less sandy, and large tracts are covered with a new species of *Saccharum*, and great tufts of a palm (*Licuala spinosa*). There are many pools full of lotus, while, in drier places, a *Clerodendron* and a small *Crinum* abound, and on the river banks dense thickets reach to the water's edge, interspersed with pink- or golden-flowered Cassias, orange and red Bauhinias and clumps of white-flowered *Clinogyne*.

The Kota Glanggi limestone rocks in the woods of the island of Tawar afforded a distinct flora, and many good finds, the most important of which were a new genus of Musaceæ, one of Rubiaceæ, a *Trichopus* hitherto known only from Ceylon and Southern India, and many new orchids.

Among the numerous interesting plants found in the woods at the mouth of the Tembeling River, at its union with the Pahang River, was a *Brugmansia*, the first of that most remarkable of orders, Rafflesiaceæ, recorded from the Malay Peninsula. Passing up the river to the valley of the Tahan, a totally distinct flora was observed. Here, the rocky river-banks are clad with a dense forest of trees and shrubs, most conspicuous of which was a new Dipterocarp, bright with pink fruit or scenting the air with large pinkish, cream flowers, while its boughs were laden with *Cœlogynes*, *Dendrobiums*, and many other

orchids in magnificent flower. A long, narrow-pointed leaf was very characteristic of the plants growing close to the water's edge, and belonging to very different orders. The author suggests that this may be a protective adaptation against the rapid rises to which the river is subject, from sudden falls in the mountain districts, thus exposing the plants to submersion by a rush of water. Broad foliage would be torn off or mutilated, but narrower leaves, offering less resistance, would be less liable to injury.

In the ravines, down which run the numerous smaller streams to join the river, were Begonias, Aroids, many Scitamineæ, and others. The soil of the woods is in many parts very sandy, and Mr. Ridley thinks that to this is due the paucity of *Termites*, as they are unable to make their subterranean nests in sand which would fall in, the stiffer clay being needed for the dome-shaped chambers and passages. Owing to their absence, the leaves and sticks on the ground decayed slowly and formed a richer soil, while in the clayey woods where white ants abound, the vegetable fragments are rapidly eaten as they fall and rendered useless for soil-fertilisation. In the upper woods of the Tahan River, the ground was permanently sodden with the heavy rains, and at night glowed brilliantly from the luminosity of the decaying leaves. The dense jungles of the Tahan River yield a good quantity of Rattans of many species, but in the more accessible country along the banks of the Tembeling and Pahang rivers, the best have been exterminated. Gutta-trees are plentiful in the Tahan districts, and Pahang gutta-percha fetches a good price.

There was very little cultivation in Pahang, although the soil in many parts is exceptionally good, much better than that to the south of the Peninsula. In the villages along the main river, maize, tapioca, sago, hill paddy, and fruit are chiefly cultivated. The Rajah of Tembeling had some very healthy young Arabian coffee trees in his garden, from the leaves of which he made a kind of tea, being quite ignorant of the use of the berries.

Mr. Ridley's list includes descriptions of three new genera, in Rubiaceæ, Asclepiadeæ, and Scitamineæ respectively, and there is also a goodly number of new species. Thus of eighteen Cyrtandreæ, nine are new, seven of which belong to the genus Didymocarpus, many of the Scitamineæ are new, and no less than twenty-one orchids, including three *Dendrobiums*, four species of *Sarcochilus*, and two of *Phalænopsis*. What seems to be the wild original form of the Patchouli was found a long way up the Tahan River, far away from cultivation; it is quite distinct from the other plants which have been supposed to be the wild parent.

THE SEEDLINGS OF CONIFERS.

THE last two numbers of *Le Botaniste* consist largely of an account of some anatomical researches on the seedlings of Conifers by the

editor, P. A. Dangeard, who claims, among other things, to have put beyond doubt the existence of an intermediate tigellar region distinct from both stem and root, often reaching above the cotyledons, and "possessing a veritable autonomy." He also discusses the varying and often large number of cotyledons in Gymnosperms, which contrasts so markedly with the pair or single one found in the dicotyledons and monocotyledons respectively.

Thus the stone pine (*Pinus pinea*) has 11 to 13, the corsican pine (*P. Laricio*) 8, in the scotch fir the number varies from 6 to 9, in the larch there are 5, 6, or 7, in the white spruce (*Picea alba*) 5 to 7, and so on. One theory explains the large number of cotyledons by the development of new leaf-structures between the original members, while another supposes the subdivision of already existing cotyledons.

The former idea is recalled by the study of the germination of the cypresses. In *Cupressus Lindleyi*, for instance, the internode immediately above the three cotyledons is much shortened, although the following ones are well-developed. The first whorl of three leaves is thus brought on a level with the cotyledons, of which the seedling seems to have six, the three true cotyledons being distinguishable only by their smaller size. Similarly, *Cupressus Corneyana* has apparently four cotyledons. It is, therefore, conceivable that by a gradual approach of the origins of the seed-leaves and those of the succeeding whorl a permanent increase in the number of the former might be effected. Anatomy, however, does not favour this view, as in the cases examined, only the vascular bundles belonging to the cotyledons are inserted on those of the primary root, and M. Dangeard is of opinion that the increased number is due to the division of two large cotyledons, and he derives the numerous cotyledons of the Abietineæ from *Araucaria* or some closely-allied ancient genus. Examination of the seedling of the Chili pine or monkey-puzzle (*Araucaria imbricata*) will easily show how the transformation has been produced. Each of the two cotyledons has a small number of nerves which unite at the base of the leaf into a single bundle; these nerves have become independent and formed as many distinct cotyledonary bundles in the axis, while the limb of the two large cotyledons has split between each bundle, forming as many lobes. The mode of germination thus constructed recalls strikingly that characteristic of the Abietineæ, and of *Pinus* in particular. Variations occur in the genus *Araucaria* which favour this idea; the total number of nerves, instead of being distributed between two cotyledons, may be divided among three, or sometimes four; while, on the other hand, if we examine the course of the cotyledonary bundles and their relations with those of the root in a seedling of the stone pine, we observe, when the number of cotyledons is odd, a fact which recalls the original union of their bundles; some namely uniting with others and not being directly inserted on those of the root. The author remarks that this theory is at any rate not contradicted

by what we know of fossil Conifers; *Walchia*, a genus allied to the subgenus *Eutacta* of *Araucaria*, appears in the Upper Carboniferous, while the pines begin only at the Lias. On the other hand, it is generally agreed that the Abietineæ show close affinities with the Araucarieæ.

The Respiration of Plants.

In Pringsheim's *Jahrbücher* (vol. xxv., p. 1) there is an account of some investigations by Anton Amm on the intramolecular respiration of plants. With regard to the relations between the amount of carbonic acid produced in this function and the degree of temperature to which the plants were exposed, it was found that the minimum temperature, as in the case of normal respiration, was below freezing point, since at 0° C. a significant amount of the gas was given off. As the temperature rose, intramolecular respiration also gradually increased, but this increase was not proportional to the rise of temperature. In both Wheat and Lupine seedlings the optimum was reached at 40° C., which coincides with the optimum for the normal process. On the other hand, while there is, doubtless, a maximum temperature for the latter function, in the case of the wheat plant and *Lupinus luteus* somewhere about 45° C., there can, properly speaking, be no such point in the intramolecular process, since in absence of oxygen, seedlings cannot stand temperatures between 40° and 45° C. without prejudice to their vitality, and the rapid fall in the respiration curve when the optimum temperature is passed is due to the commencement of death.

The author finds the relation between the amounts of carbonic acid formed in the normal and intramolecular processes to vary with the temperature. Thus in the case of the wheat the relation $\frac{I}{N}$ decreases in passing from 0° to 25° C., and then increases regularly up to 40° C. The values obtained with the Lupine, except for some fluctuations, show a similar fall and rise; the minimum is, however, reached at 35° C., not 25° C.

The relation between the amounts of carbonic acid gas formed in the two processes varies in different stages of development of one and the same plant, the fraction $\frac{I}{N}$ increasing with increasing development. The present investigations have also supplied fresh confirmation of the fact that, by the withdrawal of oxygen, production of carbonic acid at once sinks in amount but remains constant for a long time at the lower level, and immediately rises again to the original amount when oxygen is again supplied.

Finally, the results show that the different organs of a plant, *e.g.*, flowers and leaves, give an almost identical relation between the normal and intramolecular respiration, while the organs of different species show quite a different relation.

The paper includes an account of the apparatus and methods used in these researches, as well as an historical review of the subject.

THE GROWTH OF PLANTS.

NATURE does not pose as a graceful designer in the rectangular inflorescence of *Siphonychia diffusa*, according to the description which Aug. F. Foerste gives of it in the *Bulletin of the Torrey Club*. "Here is a plant," he says, "with its flowers laid out in rectangular inflorescences—cymes with a flat top with quadrate outlines, or of a form which at once makes us wish to say parallelopipedon, as though the other dimensions were equally stiff and rectangular. In these rectangles, the flowers are laid off almost with the precision of corn rows in a field." This general effect is not lessened by the way in which the inflorescences are arranged on the stem. The latter is almost prostrate, and the cymes terminate the branches at such heights as to fall approximately all in the same plane, and being moreover disposed with their diagonals vertical or parallel to the stem, their sides all become parallel, "so that the final effect is that of a series of rectangular fields, set out in some western landscape, where all lines run north and south or east and west." The writer adds, "the plant must be seen to be appreciated."

The same author also calls attention to the renewed growth of trees in summer after having already once formed their terminal scaly winter buds. In the formation of the buds the plant is planning for the future; in many trees, the warmth of spring has hardly called the vital functions back into vigorous action before the growth for the year is completed, and a few weeks later a well-developed terminal scaly bud awaits the winter. Considerable maturing may be needed before all the characters necessary to withstand the winter's cold are acquired; but the fact is evident that "the more terminal leaves have remained in the crude state of scales when all the freshness of spring was inviting them on to full development to vigorous leaves."

The buds represent a year's growth, and before this year's is finished the tree begins to prepare for the next year's task. Hence there is a certain definiteness to the work, and we can foretell in a measure how much the plant will do from year to year. This definiteness must be related to conditions of climate found in certain areas of the plant's distribution. Northwards the relations between the number of leaves necessary for vigorous development, and the provisions for the same, are so well balanced, that it is rather rare to find woody plants renewing their growth after having once formed their terminal buds. These correlations, however, lose in value in going southward, and many trees, after having already formed such buds in the spring, start growing again in the summer, and again form terminal buds. Under exceptional conditions this may take place three or four times in the course of a year. In the black-jack oak (*Quercus nigra*), near Bainbridge, in Georgia, the author found cases of repeated renewal of growth very common. In the older trees such a growth has taken place twice this year on

certain branches, while in young shoots coming up from the roots it has been quite general. In one case, where a fire had checked development for some time by destroying the present year's growth, adventitious shoots formed scaly buds three, or even four, times. It was interesting to notice how nearly equal was the number of internodes developed each time as a striking proof of the fact that this oak has so deeply acquired the habit of producing a certain number of internodes and then a terminal bud, that it repeats this growth and termination at times when circumstances favour a single longer-continued growth before winter buds need be prepared.

Another phase of the subject was presented in some new shoots from a hickory stump, a few of which had made their long growth during one uninterrupted period. In one shoot the internodes got closer together, and the leaves smaller towards the middle of its length—evidently preparatory to the formation of a terminal bud; but the shoot, so to speak, changed its mind, and succeeding leaves became more distant and larger until, later, the real terminal bud was formed considerably farther on. In another, the leaves were reduced to scales towards the middle of the shoot, but the internodes were too long to admit of the formation of a bud, while in several cases terminal scaly buds had been developed but renewed their growth.

The Movements of Plants.

Cobæa scandens is well-known in conservatories and gardens as a graceful climbing plant. It is a native of Mexico, but has been in cultivation for more than a century. In 1805 it was figured for the *Botanical Magazine*, where it is stated that the drawing was taken in July, 1784, at Mr. Woodford's, Vauxhall. It had been previously described and figured by Cavanilles in the first volume of his "Icones," and appears to have been first raised in Europe in the royal garden at Madrid. The movements of the flower-stalk and floral organs during the flowering period form the subject of a recent paper by Max Schultz in Cohn's *Beiträge zur Biologie der Pflanzen* (vol. vi., p. 305).

During the development of the flower-bud the stalks have a strong tendency to grow towards the light and in opposition to the force of gravity, or, to put it briefly, are positively heliotropic and negatively geotropic. The axis of the young bud falls in the direction of the length of the stalk. As growth proceeds, the end of the stalk bends horizontally, and at the same time the pressure of the petals causes the hitherto fast closed calyx to open at the tip. Finally, through the more rapid growth of its upper surface, the horizontal portion dips at a slight angle, giving the flower a nodding position in which it opens. The author shows that these movements are due to the action of gravity, the end of the stalk becoming horizontally

geotropic, tending, that is, to lie in a direction at right angles to the force of gravity, while the rest still retains its original negative geotropic tendency.

The flowers are markedly proterandrous. The two upper stamens are the first to shed their pollen, the anthers standing before the entrance to the flower. They remain in this position for about twenty-four hours, and then bend back towards the interior of the flower, at the same time that the anthers of the three lower stamens open, and by curving of the ends of their filaments come to hold the same position at the entrance. After another day these have also served their turn and bend back useless towards the lower edge of the flower, while the style, which has hitherto lain concealed, grows out and curves into the position vacated by the stamens, the stigmas spreading meanwhile. A change has also occurred in the colour and scent of the blossom. While the two upper anthers are functional, the corolla is still greenish and has a pungent, disagreeable smell, but after the three lower anthers have opened, the colour is a deep dull purple, and the scent strong and sweet.

After the anthers have retired and the stigmas remained in position for another day, the upper end of the flower-stalk bends vertically downwards, and shortly after the lower portion comes to lie horizontally. Both these movements result from the action of gravity. Simultaneously with the latter movement, the upper portion undergoes further geotropic changes of position, by which the part immediately behind the flower comes to point vertically downwards, the piece between this and the original place of bending remaining horizontal. It is interesting to note that the horizontal part of the stalk has a dorsiventral structure, the cortical tissue of the ventral side being more strongly developed than that of the dorsal.

These movements of the flower and its stalk are, perhaps, a device for ensuring self-fertilisation where cross-fertilisation by insects has failed; they occur in any case, whether pollination has taken place or not.

Malformation of the Daisy.

A novel malformation in the flower-head of the common Daisy is the subject of a note by Dr. Masters in the last issue of the *Annals of Botany* (vol. vii., p. 381). The specimens were sent the summer before last as a "new British plant"; they were kept through the winter and on flowering this year have reproduced the peculiarities previously observed. The young flower-head was oblong, and the bracts of the involucre fewer in number and less wide-spreading than usual. The outer or ray-florets were of the usual colour, but only five in number; some were spreading, others erect or more or less twisted. By far the most striking peculiarity, however, lay in the disc, where, instead of a great number of separate corollas, was a single petaloid cup composed

of several corollas, apparently flattened out and united by their margins. The free border of the tube showed lobes and other signs of a composite nature. Within the cup were the stamens in a single row, very numerous, quite free, and surrounding a club-shaped expansion of the axis which occupied the centre of the flower-head. This dilatation was solid and undivided below, but above gave off a number of deltoid processes, "which doubtless represent bracts or paleæ." In no case, says the writer, was there any trace of styles, ovary, or ovule, except in the ray-floret, which enclosed a two-lobed style as usual. One is tempted, however, to suggest from Dr. Masters's figures and description, that the central head of "bracts or paleæ" might represent the carpels, which have, like the corolla and stamens, become aggregated and then also leafy in character.

It is saying a great deal for the rarity of this phenomenon when Dr. Masters admits that he has never before observed such a case in the family of Compositæ. The nearest approach is a very common malformation of the foxglove, where the corollas of the flowers in the upper part of the raceme are blended into one terminal cup.

Lepidostrobus.

Professor F. O. Bower has been examining in the light of recent advances in Palæophytology the structure of the axis of the cone of *Lepidostrobus Brownii*. This fine fossil specimen, preserved in the British Museum, was the subject of a paper, by Robert Brown, in vol. xx. of the Linnean Society's *Transactions*, where the author, as Professor Bower points out in his communication to the *Annals of Botany* (vol. vii., no. 27), described details of great importance in classification which have been neglected by subsequent workers. In the paper now before us, attention is called to the close correspondence of the tissues to those of *Psilotum*, both as regards arrangement and structure; while in the stellate, connected central xylem, the fossil bears a certain resemblance not only to the Psilotaceæ but also to species of *Lycopodium* and *Selaginella*. As the author has recently demonstrated points of similarity between the sporangia of the fossil genus *Lepidodendron* and those of *Tmesipteris*, this correspondence in internal anatomy between *Lepidostrobus* and the Psilotaceæ becomes especially interesting.

In a comparison of the cortex of living Lycopods and Psilotaceæ, of the *Lepidostrobus* and stems of *Lepidodendron*, the author shows that while considerable variety of detail is manifested, it is possible to match the different types of structure found in the fossils with similar characters in closely-allied living forms. He also concludes, by a consideration of another set of examples, that the well-known trabecular development in *Selaginella*, traces of which also occur in *Lepidostrobus*, is a specialised and more definite example of that

lacunar development which appears in such various forms and positions in cortical tissues of other Lycopodinous plants.

All these considerations, the author remarks, serve to draw the Lycopodinous plants of the present and past more closely together as a natural family, while it is interesting to note that the lines of similarity "do not focus themselves specially between any two genera, but are such as to suggest complex cross-relationship between the several representatives of this very natural series."

B. H. Halsted has been investigating (*Bull. Torrey Botanical Club*, October) a disease which has, in the last two or three years, become very common among hot-house Pelargoniums in the United States. The leaves lose their healthy green colour, and become speckled or blotched with yellow, while corky ridges are found on the stem and petioles, and the whole plant may become sick, stunted, and useless. The usual appearance on the blades is that of numerous specks, which seem to be supercharged with water, giving the part a clear amber look when held up to the light. A similar appearance in Carnation leaves, previously studied, was known to be due to micro-organisms, but, on investigation, no trace of bacteria or infection by inoculation could be found in the Pelargonium, and it was concluded that the plants were suffering from a dropsical affection due to excess of water and insufficient light. Professor Atkinson has described a similar trouble which he calls Œdema of the Tomato. The remedy would seem to be a cooler, drier soil and increased light for the aërial parts wherever possible.

An explanation of the want of accord in the results of estimation, by methods hitherto used, of theobromin and caffein in specimens of tea and coffee, preparations of cacao and cola nuts, is supplied by some recent work by A. Hilger and other chemists, on the cola nut and seeds of the cacao. In both of these there exists a nitrogenous glucoside, from which caffein or theobromin respectively, besides other compounds, are produced by action of a diastatic ferment, also present in the seeds. The authors succeeded in isolating both the glucoside and the ferment. To get trustworthy results in the estimation of theobromin or caffein, the glucoside must be completely split up before these bodies are isolated. In the cacao it is broken up into theobromin, dextrose and a non-nitrogenous body, cacaoroth, while with the cola nut an analogous reaction obtains, caffein and kolaroth being formed. For details, the reader is referred to the *Deutsche Vierteljahrsschrift für öffentliche Gesundheitspflege*, vol. xxv., pt. 3.

In the *Annals of Botany* Mr. E. H. Acton gives the result of an analysis of wheat grain grown near Canterbury nearly thirty years ago, and threshed in 1892, and compares it with some of last year's

crop from the same field. As was to be expected, the old grains contained much less water than the new, the proportion being 9 and 14 per cent. respectively, while the insoluble food-material stored in the seed, such as proteids and starch, were found to have changed considerably in the direction of compounds soluble in water. Thus whereas in the new wheat scarcely one-seventh of the proteid matter was thus soluble, in the old nearly half dissolved, and while no sugar was found in the new, and only just over 1 per cent. of dextrins, the old contained 6·2 per cent. sugars and 6 per cent. dextrins; with, of course, less starch. These changes are probably the result of the action of ferments which were originally present, but have since perished, as the power of converting starch or proteid was found to be nil. This being the case, it is not surprising to find the author describing the old sample as "apparently dead," having shown no signs of germination under favourable conditions maintained for two months. In the absence of ferments to break up the insoluble albumen, starch, &c., the supply of food and energy required for germination would be unattainable.

NATURE lovers in our own country are often pained by the vandalism of so-called naturalists, who, possessed with the rage for collecting, threaten the existence of our rarer plants and animals. Now, according to the *Orchid Review* (November), the Rajah of Sarawak is closing his dominion to collectors, owing to the depredations committed by orchid hunters and the like. It is scarcely to be wondered that a man objects to have the rare and beautiful objects of the fauna and flora of his country carted off wholesale to gratify the passing whim of a moneyed class in another hemisphere.

MR. G. F. SCOTT ELLIOT is again in Africa on a botanical and generally scientific expedition. This time his destination is Uganda, which he hopes to reach *viâ* Mombasa and the Victoria Nyanza. Mr. Elliot, who is known to readers of NATURAL SCIENCE as well as to botanists in particular, has already touched the great continent at several points. A few years ago he made a trip through the Transvaal and Natal, and shortly after spent some time in Madagascar. His next visit was to the North, where he was anxious to work at the Morocco Flora, but, owing to political disturbances, was unable to get into the State, and so went on to Egypt, and collected up the Nile, as far as the Wady Halfa. Finally, about two years ago, he visited Sierra Leone as botanist to the Boundary Commission. The scientific results of these expeditions have been published in the Linnean Society's *Journal* and the *Annals* and *Journal of Botany*. Uganda is a promising field, and we wish Mr. Elliot a successful trip and a safe return with a rich harvest of results.

MR. ERNEST GEDGE, whose admirable letters to the *Times* as Special Correspondent of that paper in Uganda are, doubtless, well known to all our readers, has just returned to the coast, and is now on his way to Matabeleland. Mr. Gedge's hasty return is to be regretted, as otherwise he would, probably, have carried out his original programme and visited the unknown but important region between Elgon and Karamoyo on his way back to the coast.

MR. HERBERT WARD has an article in *The English Illustrated Magazine* for November entitled "Martyrs to a New Crusade." He gives a brief sketch, with portraits, of those of Stanley's companions who passed away, either during the last expedition, or from privations endured while attached to it. Major Barttelot, Thomas Heazle Parke, James Sligo Jameson, Robert Nelson, and Captain Stairs, are pathetically sketched by their comrade, who also pays a tribute to the fidelity of the black followers.

THOSE interested in slugs will find in the December 21 number of *The Conchologist* the completion of Professor Cockerell's Check-List of those molluscs. It is difficult to estimate the value of these publications, where one can find forms described in widely-scattered publications all collected together for the first time. The author knows as well as his critics the weak points in his list, and offers it for destruction and re-construction, until reasonable finality is reached and permits of a revised edition.

The editor, Mr. W. E. Collinge, has made sundry comments upon the notes of the author, and these, though in many cases apt, are testy, and do not, moreover, justify the insertion of Mr. Collinge's name on the title as joint-author. One remark of Mr. Collinge's at first strikes one as very sound, viz., that modern science "demands a knowledge of internal as well as external morphology, and *rightly refuses to recognise inadequate descriptions, or descriptions of shells apart from the animal, or to acknowledge genera or species founded upon purely external features*." But, however much we may deplore the naming of a shell without study of the mollusc which produced it, we must not forget the difficulty in most cases in obtaining the animal, and it is a debatable question whether it is not better to name the shell when found, rather than wait for the soft parts to be forthcoming. In any case, we hope that Poli's idea of naming both the shell and the mollusc will not again come into favour.

THE siphuncles, or, to speak more correctly, the siphuncular tubes of the straight forms of Palæozoic Cephalopoda present many variations in structure that greatly puzzle the morphologist. In some interesting "Remarks on Specific Characters in *Orthoceras*" (*Amer. Geol.*, vol. xii., pp. 232–236), Aug. F. Foerste adds an item to our

knowledge by showing that in *Orthoceras erraticum* the siphuncle moved, during the growth of the shell, from one side to the other, while the siphuncular tube became less annular and more cylindrical. Similar movement of the siphuncle is known in coiled Ammonoidea, and may be accounted for by the coiling; but one fails to see its meaning in a straight and regularly conical shell.

ANOTHER curious instance of variation in Cephalopoda is recorded by A. Appellöf (*Bergens Museums Aarbog* for 1892, p. 14, just published). In all Octopoda one of the arms, usually the third on the right, undergoes a peculiar modification for reproductive purposes, which is known as "Hectocotylisation." In a specimen of *Eledone cirrhosa*, Dr. Appellöf has found the third arm on the left also similarly affected, without, however, any corresponding duplication of the genital opening.

THE clever sketches called "Zigzags at the Zoo," published in recent numbers of the *Strand Magazine*, are above the average. We do not remember to have seen anything more funny than the drowning of the two bluebottles by the rhinoceros, "Tom." Mr. J. A. Shepperd has exactly caught the flap of the ears, and his drawings are full of suggestion and life. The comparison of the racoons to a couple of well-known music-hall "artistes," if not in the highest degree scientific, has a sense of humour doubly dear to one whose wits have been much muddled by ponderous verbosity; while no one, after laughing over the illustration, will fail to remember that "*These animals bite*."

AN elaborate memoir, entitled "A Contribution to the History of the Geology of the Borough of Leicester," by Mr. Montagu Browne, has been published by the Leicester Literary and Philosophical Society (*Trans.*, vol. iii., pp. 123–240). It contains a very full account of all that is known about the Keuper and Rhætic Beds, the Lower Lias, and the Glacial Drifts; with notes on the Water Supply. The Palæontological Tables enumerate the fossils found in the several formations in the district, including the "derived" specimens obtained from the Boulder Clay, and those found in Pleistocene valley-gravels and more recent deposits. The authorities for each record are noted by means of a somewhat complicated system of symbols.

AN excellent account of the Geology of Dublin and its neighbourhood, from the pen of Professor W. J. Sollas, appears in the *Proceedings of the Geologists' Association* (vol. xiii., pp. 91–122). It is well illustrated, and was intended as a guide to the members of the Association who visited Dublin and Wicklow last July.

We learn that Professor Huxley will contribute a final chapter to the "Memoirs of Professor Owen," which are promised early next year. This will be an estimate of Professor Owen's work, and the scientific public will await with considerable interest the words of one so peculiarly and eminently fitted to deal with this important subject.

Apropos of the article in our last number on Natural Science at the Chicago Exhibition, we may mention that the *American Geologist* intends to give very full accounts of all the geological exhibits at the Fair. The October number contains a description of the Geological Maps and Models, and also gives a summary of the proceedings at the World's Congress on Geology, which was held in Chicago during the week August 21 to 26.

It is announced that *The Conchologist*, a quarterly journal edited and published by Mr. W. E. Collinge, of the Mason College, Birmingham, will be known in future as *The Journal of Malacology*, the first part of vol. iii. being issued in January, 1894. For the present, it will deal almost exclusively with the slugs, and its aim will be to focus within one journal abstracts of the current literature relating to these molluscs, while affording a means of publication for original work.

Our reviewer, when he wrote the recent notice of the *Zoological Record*, must have been gifted with second sight; at all events, no more apt illustration of his ironical remarks anent the customary mode of reviewing that work could have been afforded than the notice which made its appearance but a day or two later in the columns of a weekly contemporary (*Athenæum*, November 11).

The whole notice is literally taken up in calling attention to those misprints and other oversights from which, owing to human frailty and the direct interposition of the printer's devil, a work of this character is never free. The only suggestion offered by this would-be smart critic is to repeat his last year's recommendation that the editor of the *Record* should procure a blue pencil and use it. Apparently this editorial requisite is equally wanted in other quarters, for we can hardly imagine a critique (?) such as our contemporary has admitted being allowed to appear in any other journal.

One is tempted to wonder how similar works, did they come up for review, would be handled. What, for instance, would be said about the valuable, and formerly well-edited, *Journal of the Royal Microscopical Society*? In the biological record there published we habitually find notices of papers on invertebrate embryology mixed up with those on vertebrate embryology, under the heading "A.—Vertebrata." Misprints, too, are by no means unknown there, and we have met with an instance where two papers on very different subjects, and pages apart, have politely exchanged references.

I.

High-Level Shelly-Sands and Gravels.

PROBABLY there is no subject of geological controversy that has provoked more animated discussion than the shelly-sands and gravels, found in various localities in the British Isles and Ireland, at levels ranging up to about 1,400 feet above sea-level. The question that excites geologists is the same that is reported to have troubled George the Third respecting the apples in the dumpling—how they got there. Having received a cordial invitation from the Editor of NATURAL SCIENCE to unburden myself on this topic, I gladly avail myself of the opportunity.

And here I am met with my first difficulty. I shall, in the course of this article, have to call these deposits High-Level *Glacial* Drift, which I suppose is begging the question, as their *diluvial* origin is stoutly and ingeniously contended for by no less an authority than Sir Henry Howorth. However, as I simply adopt the name that these sands and gravels are generally known by, I hope I may receive absolution.

Among working geologists of the present day only two explanations are offered as possible.

The older one, which passed unchallenged for over a quarter of a century, is that these shelly-sands and gravels were laid down when the relative levels of land and sea were different to what they are now, and postulates a subsidence of the land or rise of the sea, known as "the Great Submergence."

The newer hypothesis adopted by geologists who find various difficulties which they think are unexplained by the submergence theory, is that the high-level shelly drift is sea-bottom, not *in situ*, but carried up to its present position frozen in the sole of a glacier, or pushed up in front of it while advancing from Scotland over the bed of the Irish Sea.

It is difficult to give the precise details of how it is conceived this operation was carried on, as I have never yet been fortunate enough to meet with much more than a general statement, but one hypothesis is that the sands and gravels were released from their icy matrix by the sudden melting of the ice at the close of the Glacial Period, hence the rounding of the stones and the false-bedding of the deposits.

It is evident to anyone of ordinary common sense in scientific matters that such questions can only be answered—if they can be answered—by appeal to facts; unfortunately—or perhaps fortunately—facts present themselves in different colours to different minds, and what one looks upon as conclusive proof of the action of the sea, another thinks points decisively towards land-ice. Let us, then, shortly review what is known of these chameleon-like drifts, and try to present the information in a way that each reasoner may have an opportunity of forming his own conclusions—if, indeed, he feels equal to the task of taking so much trouble.

The first discovery of the high-level shelly drift in the British Isles was made by Joshua Trimmer, and recorded in the *Proceedings* of the Geological Society in 1831. It occurred on Moel Tryfaen, Carnarvonshire, at a level of between 1,300 and 1,400 feet.

There have been many discoveries in other localities since, but Moel Tryfaen remains classic ground, not alone on account of priority, but because of certain features which differentiate it from the other shelly-sands and gravels, of which I have given detailed descriptions and illustrations in a monograph lately published by the Liverpool Geological Society.[1] The next discovery was made by the veteran geologist, Mr. Joseph Prestwich, of a shelly patch near the Setter Dog, between Macclesfield and Buxton, at a level of about 1,200 feet above the sea. The Macclesfield Cemetery beds, at a level of about 600 feet—consisting mostly of shelly-sands some 70 feet thick—followed, and were described by the late Dr. Sainter and Mr. R. D. Darbishire.[2] Similar shelly-sands and gravels were discovered and described in Flintshire at Halkin Mountain, and up to 1,000 at Moel y Crio, by the late Daniel Mackintosh; and between Minera and Llangollen the same indefatigable observer, to whom Drift Geology owes so much, found an extension of the same shelly drift at levels ranging from 1,000 to 1,200 feet. Still more recently, these high-level shelly-sands and gravels have been traced further south, and occur at Gloppa, two miles from Oswestry, in great force up to the level of 1,200 feet above the sea, having a depth of 60 feet unbottomed. Mr. A. C. Nicholson, F.G.S., has given an excellent description of these beds[3] which, fortunately for geologists, he assiduously worked during the whole of the excavations made in carrying out the works of the new water-supply for Liverpool from the River Vyrnwy. Meanwhile, geologists in the Sister Isle were not idle, and the Rev. Maxwell H. Close recorded the presence of a remarkable deposit of shelly-gravels at Ballyedmonduff on the Three-rock Mountain, near Dublin, at an elevation of over 1,200 feet,[4] and of other exposures at various

[1] The Drift Beds of the Moel Tryfaen Area of the North Wales Coast; Session 1892-3.

[2] Notes on Marine Shells found in the Stratified Drift near Macclesfield, by R. D. Darbishire. Lit. & Phil. Soc. of Manchester, Session 1864-5.

[3] *Q. J. Geol. Soc.*, 1892. [4] *Geol. Mag.*, 1874.

levels of a similar nature, indicating a wide extension of these deposits penetrating into the northern parts of the Wicklow Mountains.

Other minor discoveries of shelly-sands, gravels, and clays have been made at various localities and at varying heights, but the purport of this paper is to deal with the prominently High-level Shelly Drifts, as bearing upon the two opposing theories of their origin.

Premising that I speak from personal observation of all the deposits the history of whose discovery I have briefly sketched out, I may say that, discounting local conditions, they have all certain characteristics in common. They are these—

1. The rocks and materials of which they are composed are largely foreign to the locality, but mixed to a greater or less extent with local materials.

2. Some of the rocks are far travelled and from different directions, but generally from a northerly direction.

3. The foreign materials are often above the level of their parent rock.

4. The pebbles, boulders, and small gravel are to a considerable but varying extent well rounded, a few are striated, some planed.

5. The sands have often all the aspects of marine sands containing a very large proportion of polished and rounded quartz grains.

In cases where local material preponderates, or materials which may have only travelled a few miles, as at Ballyedmonduff, highly-polished quartz grains are often disseminated through the mass, and can be obtained by washing and riddling.

6. As their name indicates, these sands and gravels contain sea-shells, mostly in a fragmentary condition, but often well preserved, especially the gasteropods. In fact, shells in any gravelly beach present the same aspect. The fragments are frequently worn at the edges, and microscopic grains of shell-fragments can be obtained by washing, and distinguished by the aid of the microscope.

7. The local rocks and gravelly materials are frequently angular, though sometimes well rounded—they are, as a rule, more angular than the travelled materials.

8. The gravels and sands are often well bedded, commonly current-bedded.

9. In some cases these characteristic marine beds are underlaid or overlaid, or both, with characteristic glacial till, composed almost wholly of local rocks and materials that have come down from a higher level. Moel Tryfaen is the only case in which I have seen this phenomenon, but I have no doubt there are others could we bare the ground. It can only happen in localities where there are high mountains near, commanding the site of the beds.

10. Finally, the whole aspect of the shelly-sands and gravels is that characteristic of aqueous deposits.

There are other high-level sands and gravels which, though no

shells may have been detected in them, can be identified as of the same nature and origin.

Interbedded with these sands and gravels we find beds of clay and of dirty sand and gravel, but the typical sands and gravels are very clean and require no washing when mechanically separating their mineral constituents by means of sieves of small mesh.

It must not be thought that shelly-sands and gravels are confined to the high-level localities mentioned. On the contrary, they are to be found at all levels from the sea to the highest mentioned. They vary according to locality and the nature of the surrounding rocks, but they are essentially the same deposits, whether found at fourteen or fourteen hundred feet above the sea. For instance, there is a striking similarity between the shelly-sands and gravels of Howth, near Dublin, which rise from sea-level to about 350 feet above it, and the high-level deposits already described at Gloppa, near Oswestry, 1,200 feet above the sea. The foreign rocks they contain differ; at Gloppa they are mostly from the Lake District, Scotland, and Wales, possibly some of the flints may be from Antrim. At Howth the rocks are from the northern parts of Ireland and from the west. They have not, however, been examined to anything like the same extent as in England.

The low-level glacial deposits are differentiated from the high-level by the greater prevalence of Boulder Clays in the former, and these clays are as a rule distinguished by the still greater prevalence of foreign rocks and their more frequent and intense glaciation. These clays also contain shell fragments, and on washing yield just the same mineral grains and rounded and polished quartz grains. The Boulder Clays cover a very large area of the North-West of England. They are the purest at a distance from mountain masses; near them, local materials preponderate.

I have now sketched out the salient features and differences of the high-level and low-level drifts. It would be easy to multiply details, but my object and meaning might then get deeply buried under a mass of what might be called sedimentary information. For anyone who wishes to peruse the subject, there exist papers sufficient to supply continuous reading of the most solid kind for two or three years to come. It would be interesting to know in what state of mind a reader would emerge from such a task, probably his last state would be worse than his first.

By the earlier and perhaps simpler-minded geologists who paid attention to the subject, such as Trimmer, Ramsay, and Lyell, the position of these shells in the sands and gravels not being explicable by hypothesis of cartage or kitchen-middens, carriage by birds or pilgrims, nor even by waves of translation, were accounted for by submergence of the land by subsidence. They were looked upon, in fact, as marine beds *in situ*, their heterogeneous character being due to floating ice, which brought contributions from many localities.

Latter-day geologists coming from the study of glacial deposits in other countries have felt difficulties in accepting this explanation. They have found that an ice-sheet comparable to that of Greenland of the present day best explains the phenomena in the countries in which they have studied the glacial drift, and they seek to apply the same explanations to the Drift of the British Isles. The low-level drifts are more easily dealt with on this hypothesis than the high-level, but as they are essentially of the same nature, it seems necessary for consistency' sake to apply the same explanation to both. There are also certain phenomena which are thought to be inconsistent with the submergence theory, one of them being the position of boulders at a level higher than the parent rocks from which they were derived.

Again, it is said that the high-level drift is very partial and sporadic in distribution, that there is no marine drift in the interior mountain valleys, that there are no raised beaches, that the shells are always broken as if a heavy body had moved over them, that they occur mixed in species in a way that never happens in nature; that the two valves of bivalves are never found united—that they never occur in any bed as if the molluscs had lived on the spot, and finally, the species characteristic of warmer climates are mixed with those of colder climes, such as never occur together in the sea at the present day. Furthermore, the advocates of submergence are asked to produce stones from the Drift with the remains of barnacles or other organisms upon them.

It is also roundly asserted that rocks have never been found north of their origin, and by implication never will be. It is also suggested that, if the sea has flowed over the land to such a depth as the submergers require, deep-sea beds or beds of some sort containing sea-shells *in situ*, like what we find in the so-called Clyde Beds, should be common, whereas they do not exist.

The shading off of the glacial deposits southward is also looked upon as consistent with a land-ice, and inconsistent with a sea-borne origin.[5] These are what we may classify as objections founded upon observation. I think I have catalogued the greater number, but if any are omitted I have not the least doubt that I shall be reminded of them. In the meantime, we will consider another class of objections that are physical and theoretical. The subsidence of this solid land without evidence of volcanic action seems to some minds so improbable as to demand the clearest and fullest proofs before it can be admitted. The worst is, that when one condition is satisfied and paid

[5] What are called striated pavements, in which the striæ in the boulders are approximately parallel, are pointed to as evidence of the passage of an ice-sheet. These are, however, only found, so far as I know, at low-levels in the Boulder Clay. It is considered that floating ice could not have affected the boulders in this way. I do not propose to examine now the further question of bed-rock striation which is a much wider one than the origin of the Marine Drift.

for in mental coin, the price is raised and more demanded. Granted the subsidence, another difficulty looms ahead, it must have been differential, and it is pretty positively asserted that no evidence of any kind exists of subsidence south of the British Channel. Also, if there had been differential subsidence and elevation, faults of glacial date might be looked for in the solid crust, whereas there are none.

These objections as a whole are considered by some geologists serious enough to warrant the introduction of an agent to account for them, of which, unfortunately, we have very little knowledge. This agent is land-ice, and to Greenland we are asked to project our mental vision that we may understand the Glacial Period. I am now neither denying nor affirming the former existence, or probable former existence, of an icy covering to our isles such as is predicated. If, instead of the theoretical possibilities of such a tremendous agent as is postulated being dwelt upon, we were treated to actual facts drawn from the investigation of the Greenland ice-sheet, some of us would have a more comfortable assurance of being on solid ground forming a base for the reasoning process. Unfortunately, in the absence of recorded observations, we have to fall back on theoretical considerations alone. I trust it will not be considered arbitrary, when dealing with an agent possessing such potency for work of varied kinds as is claimed for an ice-sheet, to ask for the fullest proof of its powers. Formerly the proof of the action of land-ice was looked for in the local nature of the materials of the Boulder Clay, which represented the ground-moraine, together with the preponderance of planed and striated stones. Now everything in the Drift—foreign rocks, shells, local materials, rounded pebbles and boulders, sea-sands, are all claimed as the effect of land-ice, whether found on the top of a mountain or in the bottom of a valley.

There is a system of land-ice physics worked up with astonishing ingenuity and skill by which all these puzzling phenomena are theoretically, if we admit the premises, fully explained. If delicate shells are found intact in the Drift at an inland locality such as Gloppa, forty miles from the sea, it is suggested that they have been conveyed over hill and dale simply frozen in the sole of the glacier, forgetful of the fact that the generally comminuted condition of the Drift shells had previously been claimed as a proof of the passage of land-ice across a sea bed. Other materials, such as foreign rocks, have been conveyed in the heart of the glacier, and the whole—rocks, sea-sand, shells have been washed out, rounded and deposited in stratified masses on the sudden melting of the ice which is supposed to have occurred at the close of the Glacial Period. Unfortunately, no instances are quoted of any analogous kind of work performed by existing glaciers or ice-sheets. It is of this dearth of examples that geologists accustomed to the methods of investigation pursued by Hutton and Lyell have a legitimate right to complain. We should all be glad to assent to these various propositions if adequate proof were forth-

coming, but unless some more solid food is vouchsafed us, I fear many will die unconvinced.

With so much theory and more hypotheses we might reasonably expect the theoretical physics of the ice-sheet to be quantitatively worked out. But have they been? Has anyone yet, in proof of the view that the shell-beds of Tryfaen have been pushed up from 1,200 to 1,400 feet above the level of the sea by a glacier advancing from the north over the Irish Sea bottom, calculated the thickness of the ice required at the "area of greatest precipitation" to overcome the glacier descending from Snowdonia. As concrete examples cannot be quoted of such work being performed by land-ice either in Greenland or elsewhere at the present moment, it becomes important for the support of the hypothesis that its theoretical possibility should be established. If this has been done the investigation has not come under my notice, though I have been studying glacial geology well-nigh a quarter of a century.

Unknown agencies are very unsatisfactory things to deal with scientifically. It is as easy to deny as to affirm, but as the affirmations seem to bottom upon the alleged impossibility of any other agent than an ice-sheet being able to produce all the complicated phenomena of the Drift, it will be the most reasonable procedure to examine also the validity and force of the various objections which have been urged against the older theory of submergence, and which I have in the preceding pages attempted to summarise.

We will deal with the objections to the submergence theory seriatim.

1.—*Boulders, shingle, and gravel are found above the level of the rocks from which they were derived.*

This by some is considered conclusive proof that the moving agent must have been land-ice. Here, again, we want satisfactory examples of an analogous kind drawn from existing glaciers. It seems to me much more probable that a glacier such as the Irish-Sea glacier is supposed to have been, would shear in its own substance, than that it would push sea-bottom before it uphill. The same reasoning applies to the supposititious case of the sea-bottom getting frozen into the sole of the glacier, for if this were to take place the obstruction to the movement of the ice over the sea-bottom would be increased. We may also ask where the shearing took place if not in the ice itself? It is difficult to conceive a sea-bottom frozen solid shearing under such stresses. Alternate thawing and freezing of the bottom may be suggested to meet the difficulty, but this would render the carriage of shells in the sole of the glacier without breaking more hard to conceive than ever. But may it not be justly asked whether resort to all these ingenious suppositions is not a sign of weakness?

Let us now consider what effect submergence would have. A study of any of our shores will yield ample proof that the sea works

material shorewards, and throws it up sometimes out of its own reach. In a subsiding area, material might in this way be worked up a considerable distance above its original level. I believe the sea alone is capable of doing this, but assisted by shore-ice it would be more efficacious, and would account for some of the striations on the stones.

The material in which the erratic stones is embedded is unmistakably shore sand.

The sand of Tryfaen could not have come from anywhere but the sea itself. It also has been worked uphill, for there is no local material to yield it, and the wear and polish of the grains are distinguishingly marine features.

To anyone who has paid attention to this part of the subject, its marine character is unmistakable. The rocks that have been worked uphill are, as a rule, water-worn and rounded.

2.—*The High-level Shelly Drift is partial and sporadic.*

If the high-level drift were due to submergence, say the land-ice theorists, we should find it all over the hills, whereas it is confined to a few elevated places. This seems to me to be a singular argument. According to the postulate, the whole of the Drift above sea-level has been pushed up. Lancashire and Cheshire are pretty nigh covered with Drift. So much so, that almost every boring made into the solid rock through it involves more or less change in the mapping of the Triassic beds.

This is no disgrace to the surveyors who mapped them; they could not see through the Drift—even if Drift-geologists can? If, then, the ice-sheet only leaves sporadic deposits, why is not the Drift to the height of, say, 400 feet sporadic instead of continuous? Whether placed there by an Irish-Sea glacier or by the sea itself, both high-level and low-level Drift obey the laws of gravitation, consequently the most material is found at the lower levels.

In working out this objection, the supporters of the Irish-Sea glacier unconsciously minimise the quantity of high-level Shelly Drift—there is much more in existence than they have persuaded themselves to believe. There is no occasion for me to name the localities over again, as I have stated them at the commencement of this paper. Again, it can hardly be expected that all high-level deposits laid down by the sea should contain shells, and further it is not philosophical to assume that all high-level shelly drifts have been discovered. Their discovery has generally been in the nature of an accident. I fear the advocates of the Irish-Sea glacier are continually forgetting how difficult it is to prove a negative, and, unfortunately, their arguments are too frequently of the negative kind.

But, whether laid down by an Irish-Sea glacier or by the sea, the high-level drifts have been subjected to very active denudation since, as the rainfall is much greater in these elevated localities than

on the plains, and the time that has elapsed since they were deposited, in my estimation, is certainly not less than 60,000 years. I know that some good geologists have persuaded themselves that not more than 10,000 years have elapsed since the melting of the ice, but, though respecting their opinions, I cannot agree with their premises.

3.—*The shells are always broken as if a heavy body had moved over them.*

This formula is not strictly true, especially in the light of modern discoveries. There is no doubt, however, that the generally fragmentary condition of the shells has been a source of difficulty to observers in the past. The demands of the opponents of submergence are, however, rather exacting. They ask to be shown bivalve shells with both valves united. I have personally never found them in this condition, excepting in the Clyde Beds, but I am assured by Mr. S. A. Stewart, of the Belfast Museum, that he has taken them out of the glacial beds in the neighbourhood of that city with the valves together.[6] In *Nature*[7] is the *précis* "of a most careful and important investigation into the shell-bearing clays of Clava in Nairn," in which a "shelly blue clay with stones in the lower part," 16 feet in thickness, overlain by 63 feet of Boulder Clay and sands, and reposing upon 36 feet of coarse gravel and sand and brown clay and stones, is described. "The highest part of the shelly clay is 503½ feet above sea-level, and the deposit appears continuous for a distance of 190 yards." "The shells are well preserved, neither rubbed nor striated, and the deposit is a true marine silt which, if not *in situ*, must have been transported in mass." The majority of the committee of investigation "consider the evidence sufficiently strong to prove a submergence of at least 500 feet." Here, then, appears to be the very thing the land glacialists are asking the submergers to produce; but, unfortunately, their demands are again varied, as some are not satisfied, and assume that the bed has been shifted *en masse*.

Considering that the valves of bivalves are only held together by ligaments that readily decay, it is not surprising if we do not find them in apposition in deposits which show evidence of strong current action, as most of the marine glacial deposits do, especially the high-level shelly gravels; perfect single valves are common enough and delicate univalves such as *Trophon*, *Nassa*, and the fine spires of *Turritella*.

The high-level shells are beach shells, that is, they consist of shells such as are thrown up and can be found together on many beaches. We do not, of course, get the exact *facies*, but in this connection I may say that I have found on the Crosby beach, with one exception, the whole of the shells named by Forbes from Trimmer's

[6] See Mr. Stewart's "Mollusca of the Boulder Clay of the North-East of Ireland." Proc. Belfast Naturalists' Field Club, 1879-80. "*Leda pygmæa*—Nock, Woodburne, Ballyrudder." "Almost invariably found in a perfect state."

[7] Reports of British Association papers, Section C., *Nature*, Sept. 28, 1893, p. 532.

original find on Moel Tryfaen. On the same shore, near to where I live, my sons and I have found no less than 70 species, though, probably, not more than 20 live in the immediate locality. On gravelly beaches the fragmentary shells far outnumber those that are unbroken. The glacial shelly fragments are also generally much rounded and water-worn. If we add to the ordinary effect of wave action that of shore-ice, which would prevent, except under very peculiar circumstances, the preservation of any deposit undisturbed, the mystery with which these glacial shell-beds has been surrounded is largely dissipated. Of course, it would, in some respects, be more satisfactory to meet with the shells as perfect as in a museum, but in that case I make no doubt that their glacial origin would not be admitted. The explanation of the fragmentary condition of the shells also explains why barnacles are not found on the stones. The mixture of northern and southern species takes place at the present day at Cape Cod.

4.—*The Rocks of the Drift are never found north of their origin.*

This is another sweeping statement which wants more proof than that vouchsafed us. Very little attention has been paid by observers to the point, though, doubtless, the great majority of the stones are from positions north of where they are found. The tracking of erratics to their origin is a very difficult and laborious process in most cases, as I know from personal experience. It is only where the masses of rock yielding them are in considerable force, and their character marked like Shap and Eskdale granite, that this can be satisfactorily done. It can be done, in other cases, by a system of tracking and exclusion. To differentiate Dalbeattie from Criffel granite when found in the Drift, as has been attempted, is well-nigh impossible. Eskdale granite is to be found in the Drift between Ravenglass and St. Bees, north of its origin. The rocks yielding erratics in the greatest abundance must have been the sites of glaciers, and these were principally in the Lake District and in Wales. How far north of their origin Welsh rocks are to be found cannot be known, because the sea occupies the space to the north. Charnwood Forest rocks are found in the Boulder Clay of Nottingham, and therefore must have travelled 15 miles northward (*Q.J.G.S.*, vol. xlii., p. 480). Other examples could be quoted of varying value. A great deal of gypsum is found in the Drift by the Estuary of the Dee, and this, there is every probability, came from further south, in Cheshire. There is, however, an absence of characteristic rocks south of Lancashire and Cheshire by which to trace the flow. In the high-level shelly drift the rocks, though from all levels, mostly come from localities where they may have been derived from high levels.

In my opinion, the distribution of the erratics is quite explicable by the prevalence of north-westerly winds, and by the tides. It is not probable, with a tidal current running through the "Severn

Straits" from the bight of Liverpool Bay, that many, if any, erratics would cross it westwardly from Wales.

Eskdale and Scotch granite are found along a base line from Macclesfield to Carnarvonshire, and for the two granites to be so distributed they must have crossed each other in their courses. The much talked-of Riebeckite—which is identified with that of Ailsa Craig, Professor Sollas informs me—has been found in the Drift south of Dublin; it also occurs west of Liverpool, as well as at intermediate localities in Wales. For an Irish-Sea glacier to perform this prodigy of distribution seems incredible. A glacier distributes its load in stream-lines, and the stones from one side do not cross to the other, and *vice versâ*.

5.—*If the land has been submerged, deep-sea beds containing shells in the position in which they have lived and died should be common, whereas there are none.*

This is practically number 3 objection in another form—that is, the fragmentary condition of the shells is considered to be a proof that a glacier has passed over and crushed them. The difficulty of meeting this objection is that we do not know what deep-sea beds under glacial conditions would be like. There is a physical element that is entirely overlooked, and that is the action of the tides. I have shown[8] that the whole body of water is moved down to the greatest depths by the tides, and not merely the surface.

Most of the glacial beds that I have seen bear the marks of this disturbance, in the form of current bedding, especially the sands. The sands are intercalated in the clays, and it is difficult to separate the one from the other. The Boulder Clays, according to my interpretation, bear the marks of current action also in the smallness and rounded nature of the shell fragments, the roundness of the grains of sand and their high polish, and the manner in which sand-beds occur therein. The proportion of sand to clay is generally very considerable, the small gravel is also often highly polished and rounded. Numerous examinations of low-level Boulder Clays by washing, sifting, and separation of the grains, impresses me very strongly with the enormous wear which every constituent particle of the Boulder Clay has undergone, something totally different to what is seen in sand washed out of a living glacier which is uniformly angular. It is, therefore, quite probable that such deep-sea beds as are asked for do not occur in tidal seas, or if they do, only in exceptional positions. It is true the dredge brings up live shells from the sea-bottom now, but it is a surface gleaning, and the shell fragments are usually much more numerous than the living examples. Molluscs dying on the bottom of a tidal sea would not lie undisturbed, they would be rolled about with each tide, so that it is quite possible that undisturbed beds may not be accumulated.

[8] Tidal action a geological cause. *Proc. L'pool. Geol. Soc.* Session 1873-4; also *Phil. Mag.*, 1888, vol. xxv., pp. 338-343.

These considerations may not be deemed conclusive, but neither is the objection. We want more knowledge to speak positively either way. Also we have not examined the *whole* of the Drift yet, so that it contains many unknown possibilities.

6.—*A Subsidence of the land to the required depth is an improbability.*

I confess the attitude of mind which this statement discloses is one I have a difficulty in comprehending. There is no known fact in physical geology on surer foundations than that the land in all known continents and islands has undergone considerable fluctuation of level. Some land glacialists admit it as regards elevation and even invoke former continental elevation as *the cause* of the Glacial Period. They are unwilling to admit subsidence, but the clearest evidence up to 5,000 feet is to be obtained in North America and to 1,000 feet in Greenland,[9] and examples could be quoted from well nigh the whole world. I am not speaking now of aught but post-Tertiary subsidence. Our own coasts in the presence of buried river channels far below low-water bear the marks of subsidence. If we are prepared to dispute their evidence it will be necessary to recommence the study of geology on a new basis.[10] There is no evidence of any kind to indicate that this sort of elevation and subsidence takes place by or is accompanied by faulting, but plenty to show that it is by the bending of the earth's crust and differential vertical movement shading off to nothing.

CONCLUSIONS.

Having now to the best of my ability fairly stated the case against submergence as an explanation of the marine glacial beds, it will be well to consider the general nature of the objections. A very little examination will show that the criticisms are largely based upon negative evidence, which may become invalid at any moment by further discovery.

The allegation of the extremely partial nature of the high-level shelly gravels is, I have shown, not borne out by facts, and every additional discovery of shelly drift weakens the argument. That no perfect shells, or shells with the two valves in apposition, were to be found in the Boulder Clay is an assertion that is already disproved, and more examples in the same direction may be forthcoming.

That the erratics, including in this term all foreign rocks whether occurring as pebbles or boulders, are not found north of their origin, is another objection which has not been proved. The absence of deep-sea beds such as the land glacialists demand, is a further statement of the same sort that it is impossible to prove. There remain, then,

[9] De Rance, *Glacialists' Magazine*, August, 1893, p. 6.

[10] Since this was written, Dr. Geo. Dawson (*Proc. Geol. Soc.*, Nov. 8) has described the finding of Mammoth remains in the Pribilov Islands and Alaska, indicating a former land-connection of the North American Continent with Asia, and therefore a subsidence either during or since the Glacial Period.

only two arguments to answer, namely, the occurrence of boulders at a higher level than the parent rocks, and the supposed improbability of a subsidence of the land to the extent required by the submergence theory. The former I have shown is explicable by ordinary sea action assisted by shore-ice, and the latter is no improbability but a difficulty born of unfamiliarity with ordinary geological phenomena.

It is now time to turn our attention to the difficulties presented by the alternative hypothesis—that of the Irish-Sea glacier—and here, indeed, we are at a loss where to begin, they are so many and various. A huge machinery of ice-sheets is called in to explain the carrying up of boulders above their origin, though no examples of the power of ice-sheets to do this are given. The crushing of the shells is referred to the same agent, though many examples are known of glaciers passing over soft beds without disturbing them. At the same time, delicate shells found on elevated lands far inland have to be accounted for, and it is suggested that they have been safely conveyed frozen in the ice-sole of the Irish-Sea glacier which carried them over hill and dale to be washed out and deposited on the final melting of the ice. The rounding of the gravel and boulders and their deposit on the hill-tops, it is said, took place in a somewhat similar manner; but, as usual, no existing examples of such action are referred to, nor is it explained why the deposits on hill-tops should be more water-worn than those on the plain. To account for the distribution of the erratics, either several glacial and interglacial periods are required, of which there is no record, or a most extraordinary set of currents of ice and undercurrents are postulated; everything, in fact, except vortex movement. Yet, with all this complicated machinery, none have been able, in theory, to satisfactorily get the *stones on one side of the Irish-Sea glacier carried to the other side.* Finally, the physics of the ice-sheet are not subjected to a quantitative test.

When we call up before our mental vision the simple and well-known facts of nature which suffice to explain the marine drifts on the theory of submergence, it seems unnecessary to resort to the ingenious and artificial system of physics elaborated to explain the phenomena by land-ice.

When we have more knowledge of the glaciers of the Arctic Regions, and facts, in place of ingenious suppositions, to base our reasoning upon, we may possibly have to revise all our glacial conceptions. In the meantime, the submergence theory of the origin of the high-level shelly gravels and sands seems to me by far the simpler of the two theories, and the most consistent with the facts and phenomena which the labours of a succession of enthusiastic geologists have made us acquainted with.

T. MELLARD READE.

II.

Some Facts of Telegony.

TELEGONY is a term recently proposed by Professor Weismann to denote the influence which a first sire is believed by many breeders to have on the offspring of the same mother by a second sire. In his second article on "The All-sufficiency of Natural Selection," which recently appeared in the *Contemporary Review* (1), and in his lately-published book "The Germ-Plasm," Professor Weismann states his belief that the evidence for this phenomenon is not sufficiently convincing to establish it as a fact. This, I venture to think, may possibly arise from an insufficient examination of the evidence. Telegony is, no doubt, as Mr. Romanes concludes, a rare occurrence; and hence it is quite possible for breeders of large experience never to have met with a case, as has happened, according to Professor Weismann, with Settegast, Nathusius, and Kühn, in Germany. Mr. Tegetmeier also, our greatest authority on poultry, recently stated in the *Field* that, with fowls, the influence of the last sire is prepotent. Nevertheless, the well-known physiological variability of animals, which is as marked as their differences of form and colour, must surely be taken into account; and I hereupon proceed to give some cases which seem difficult of explanation on any other than the Telegonic theory. And first, with regard to horses, I should not mention Lord Morton's celebrated mare, as the case has been so often quoted, were it not for the fact that Professor Weismann quotes Settegast to the effect that in the drawings by Agasse of the striped colts borne by the mare to the black Arab after the quagga-hybrid, which are preserved in the Museum of the Royal College of Surgeons, no resemblance to the quagga is perceptible beyond the stripes.

Darwin (2), who mentions that these colts had also stiff, quagga-like manes, does not, according to Professor Weismann, seem to have known of these drawings; but Dr. Alexander Harvey (3), whose very interesting pamphlet "On a Curious Effect of Cross Breeding" is referred to by Darwin, quotes therein McGillivray (*Aberdeen Journal*, March 28, 1869), who mentions the case of a mare belonging to Sir Gore Ouseley, which, after bearing a hybrid to a *Zebra*, produced to horses two striped foals, whose portraits and skins are said to be in the Museum above mentioned. Since Dr. Harvey also

mentions Lord Morton's mare, it would seem that Settegast, and not he, has confused two distinct cases here. At any rate, it would be well that these pictures should be re-examined, and their history clearly stated.

In this same pamphlet McGillivray is the authority for two other curious cases, both occurring in pure horses. In several foals, in the Royal stud at Hampton Court, the progeny of the horse Actæon, there were unquestionable marks of the horse Colonel, to whom the dams of these foals had been put the previous year. Also a colt, the property of the Earl of Suffield, the son of the horse Laurel, so resembled another horse, Camel, "that it was whispered, nay, even asserted, at Newmarket, that he must have been got by Camel." It was found, however, that all that connected them was that the colt's dam had been put to Camel the previous year.

I do not think that the case of the onager's foal at the Zoological Gardens, recorded by Mr. Tegetmeier in the *Field*, in December last, is so unmistakable an evidence of Telegony as Dr. Romanes (4) appears to think. The onager was put to an Abyssinian wild ass, produced a hybrid, and then bore to a male onager a chestnut foal with a white blaze on the forehead; but as this foal thus resembled neither parent, and in fact exhibited a horse's rather than an ass's marking, the case is surely one of Analogous Variation.

With respect to the case of Carneri's cattle, alluded to on page 385 of "The Germ-Plasm," it is noticeable that Carneri, who, since he kept a herd, had presumably some experience of cattle-breeding, evidently considered the germ-infection theory more reasonable than that of reversion to a previous cross. Professor Wallace (5), in his book on the farm live-stock of Great Britain, cautions breeders against putting a mongrel bull to good cows, as well on this account as for general reasons against keeping bad stock; and Mr. Bourne assures me that this is a matter of practical consideration with cattle breeders.

In sheep, besides the interesting instance given by Darwin of some Merino ewes, which after being put to a Merino ram with neck-lappets, bore lambs with this abnormal character to other sires, there is a very remarkable case given by Dr. Harvey, on the authority of Mr. W. M'Combie, of Tilliefour, Aberdeenshire:—

Six very superior pure-bred black-faced horned ewes, the property of Mr. Harry Shaw, in the parish of Lochiel-Cushnie, in Aberdeenshire, were put, in the autumn of 1844, some to a Leicester (white-faced and polled), and others to a Southdown (dun-faced and polled) ram, and produced cross-bred lambs. In the autumn of 1845 the same ewes were put to a very fine pure black-faced horned ram (*i.e.*, of their own breed). The lambs were *all* polled and brownish in the face, much to Mr. Shaw's astonishment. In autumn, 1846 the ewes were again put to another very superior ram of their own breed. Again the lambs were mongrels, not showing so much of the alien breeds as

those of the year before; but two were polled and one dun-faced, with very small horns, while the other three were white-faced, with small round horns only. Mr. Shaw at length parted from those fine ewes, without obtaining from them one pure-bred lamb.

In the case quoted by Darwin of a sow of Western's black-and-white breed, which, after bearing to a chestnut wild boar a litter of cross-bred pigs, produced long after his death, to a boar of her own breed, pigs showing chestnut markings—though this might be put down to reversion, it is noteworthy that Harvey, who mentions this case, adds that on a *subsequent* impregnation, still by a boar of her own breed, she yet produced pigs, some of which were *slightly* marked with chestnut.

Youatt also says (6): "The boar to whom the sow has her first litter of pigs has a considerable influence on future litters, especially if of a very pure breed. In one instance a black sow was put to a white boar, and afterwards continuously to a black boar for three litters, yet in all these three litters there were white or black-and-white pigs."

In the "Book of the Rabbit" (7), Mr. Edward McKay, I believe a well-known breeder, is quoted as saying, "The influence of a first sire sometimes extends for generations, *i.e.*, influence of previous sires over offspring by other sires out of the same dam. I have known curious cases, which I cannot help thinking are the result of the above; for instance, a silver-grey doe was put to a Himalayan buck, afterwards to a Dutch sire, and afterwards to a buck of her own class, and in every succeeding litter, for several generations, were youngsters of all the above kinds. This may seem improbable to some, but, in my mind, no doubt exists."

In the case of dogs, Herr Lang, of Stuttgart (quoted by Professor Weismann), and Dr. Romanes have only got negative results, and in response to an appeal by Mr. Tegetmeier for facts on this subject, Mr. W. Godwin (8), of Market Drayton, in the *Field*, of Oct. 14, 1893, remarks that in numberless cases he has failed to notice any influence of one sire on succeeding offspring by another. However, he gives some instances of this, for which he can vouch, both with dogs and fowls. Those relating to dogs are as follows:—

A spaniel bitch littered to a terrier; all were destroyed, and in the next litter, to a spaniel, one was more like a terrier than a spaniel, the rest being true spaniels. An Irish terrier bitch, mated with a fox terrier, and bore her next litter to a well-bred Irish terrier; most of the last were like, apparently, pure Irish, two or three were red and white, one was all white, except a brindle red mark on the head and another on the stern, and strongly like a fox-terrier, except in size. A cocker-spaniel bitch, when being taken to a curly black spaniel, escaped and paired with a pointer, but was re-captured and paired to the spaniel in a very short time. Yet the resulting litter were half-bred pointers, save one, which was undoubtedly got

by the spaniel; but this in form and habits showed traces of pointer blood.

With birds, the conditions differ widely from those present in the case of mammals, since in the former class there is no possibility of the infection of the maternal blood by a cross-bred fœtus; yet there is evidence of the telegonic phenomenon in them also. Mr. Lewis Wright (9) is so convinced of its occurrence that he says, "We would never on any account allow a male bird of any strange breed to enter, even for a day in winter, a yard of hens which we greatly valued." He gives some instances, from which I select the following:—

A Mr. Payne, in England, had two Spanish pullets running with both a Spanish and Cochin cock. After they began to lay the Cochin was removed, and *six weeks* after the eggs were saved and set, but the chickens were feather-legged, in all other points resembling the Spanish.

In America, a breeder of game finding a neighbour's feather-legged bantam cock came over his fence, penned in his fowls securely, and saved no eggs for a month after, but several chicks still had feathered legs, though with no other sign of the cross. Dr. Harvey, who favoured the theory of maternal infection by the fœtus, states, as proof that telegony, as would be expected on this view, does not occur in birds, that he has been assured that crossing with a bantam during one season does not affect the progeny of a common hen during the next.

But Mr. Godwin, quoted above, also gives some instances of the working of this principle with fowls. A Dorking hen (5-toed, with bare white legs), after running with a Dorking cock, was put to a dark Brahma (4-toed, with feathered yellow legs.) The eggs on the two following days produced pure Dorkings; the egg on the third or fourth day a Dorking with three or four feathers on one leg; the next egg a feather-legged Dorking with four toes only on one foot, both legs being white; the next egg, and all after, yellow-legged birds, with a lot of feathers, as if the influence of the sire were progressive. This case came to his knowledge some thirty years back.

In Mr. S. Fielding's yard, at Trentham, Mr. Godwin saw some young fowls of game character, yet with a decidedly mongrel look. They were the offspring of a Silver Hamburg pullet, which had been running with a game cock, and three weeks had been allowed to elapse after her removal from him before any eggs were set; yet this was the result.

It is obvious that some of the cases above given can hardly be set down to reversion, feather-legged fowls and polled sheep not being ancestral types; nor is previous crossing a likely explanation. Before concluding, I may mention a remarkable fact stated in Professor Newton's new "Dictionary of Birds" (10); according to this, Nathusius came to the conclusion that by microscopical examination, which

reveals differences between eggs of birds of various species, the egg of a bird paired with an alien male may be distinguished from one laid by the same bird with a mate of her own species. And Mr. A. G. Butler (11) affirms that a canary in his possession laid eggs coloured and marked like those of a chaffinch, when paired with a male of that species. Experiments are much needed on these points; and since we fortunately have in domestication birds nearly allied, yet perfectly distinct in species, such as the Muscovy and common ducks, Chinese and common geese, Guinea fowl and common fowl, and collared turtle-dove and pigeon, it is to be hoped that someone will be sufficiently energetic to experiment with some or all of these; hence, he may thus help on the solution of more than one debated question interesting to scientific men in general, for the same series of experiments might be made to throw light on Hybridism as well as on the subject of this paper.

REFERENCES.

1. **Weismann, A.**—"The All-Sufficiency of Natural Selection—II." *Contemporary Review*, 1893, and "The Germ-Plasm," 1893, pp. 384, 385.
2. **Darwin, C.**—Animals and Plants under Domestication, 2nd ed., vol. i.
3. **Harvey, A.**—On a Curious Effect of Cross-Breeding, 1851.
4. **Romanes, G. J.**—*Nature*, September 28, 1893, pp. 515, 516.
5. **Wallace, R.**—"Farm Live Stock of Great Britain," 1893.
6. **Youatt, W.**—"The Pig." Sidney's enlarged edition, 1860.
7. **McKay, E.**—"The Book of the Rabbit," 1889.
8. **Godwin, W.**—*Field*, October 14, 1893.
9. **Wright, L.**—"The Poultry Book," Popular Revised Edition, 1891.
10. **Newton, A.**—"A Dictionary of Birds," Article Egg, 1893.
11. **Butler, A. G.**—*Zoologist*, May, 1893.

Frank Finn.

III.

Further Notes upon Arachnid and Insect Development.

IN an article in NATURAL SCIENCE (June, 1893) I gave a summary of some recent memoirs upon the classification of arachnids Mr. Goodrich has since (NATURAL SCIENCE, September, 1893) kindly pointed out that the views of Mr. Pocock on the relationships of the arachnid orders, therein set forth, agree in the main with those put forward twelve years ago by Professor Ray Lankester (1), in his memoir advocating the arachnid affinities of the King-Crab.

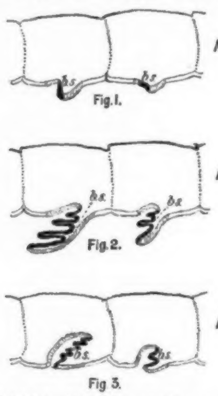
Ever since the appearance of that well-known paper by Professor Lankester, *Limulus* has been an animal of exceptional interest to zoologists. The recent publication by Mr. Kingsley (2) of a detailed description of the embryology of the King-Crab is therefore worthy of special notice. His results, on the whole, strongly support the arachnid affinities of *Limulus*; its development is shown to have but little correspondence with that of Crustaceans.

The structure of the ovary resembles that of scorpions, spiders, and mites. The ova are developed from the columnar epithelium of the ovarian tubes, and pass into a space between the epithelium and the tunica, which, at first, are in contact with each other. The segmentation of the egg proceeds by delamination, similar to that observed in various spiders, harvestmen, and mites. The mesoderm arises by proliferation from the thickened region of the blastoderm, and cœlomic cavities are formed in the somites by the splitting of the mesoderm into two sheets. The body-cavity of the adult is, however, due to secondary spaces in the mesodermal tissues. Each cœlomic cavity becomes divided into a dorsal and a ventral part; the former is believed to give rise to the generative glands; the latter is lost in most of the somites, but in the fifth it develops into the coxal gland (nephridium). This corresponds with the fate of the cœlome and the origin of nephridia in *Peripatus* and in arthropods generally;[1] it specially recalls the origin of the coxal glands in arachnids.[2] The formation of the alimentary tract agrees with what occurs in arachnids, and contrasts with the corresponding process in crustaceans, for, while the stomodæum is long, the proctodæum is short, and late in its appearance. Mr. Kingsley states that his results are, in the main, confirmed by the researches of Mr. Kishinouye (3) upon the development of *Limulus longispina*.

[1] NAT. SCIENCE, vol. i., p. 282. [2] *Ibid.*, pp. 524, 525.

In giving an account of the development of the gill-books of *Limulus*, Mr. Kingsley refers to Mr. Laurie's views on the relationship of these organs to the lung-book of arachnids,[3] and ingeniously shows that the reversal of the faces of the appendage suggested by Mr. Laurie is not necessary. From the embryonic appendage with invagination behind it (Fig. 1), can be derived the gills of *Limulus* (Fig. 2) or the lung of an arachnid (Fig. 3), the folds in the latter case, though on the forward side of the invagination, really corresponding with the hinder surface of the primitive appendage.

No details of the nervous system are given by Mr. Kingsley, but its development and adult structure have been lately described



FIGS. 1-3.—Diagrams of (1) Primitive Appendages, which develop into (2) Gills of *Limulus*, or (3) Lungs of Arachnid. A—Anterior aspect of animal; *b.s.*—Blood-spaces, which are seen to correspond in all three figures. [After Kingsley.]

by Dr. Patten (4), who shows the correspondence of the embryonic brain of *Limulus* with that of scorpions, spiders, and insects. He describes a pair of cephalic lobes with three divisions, from which are developed the large "cerebral hemispheres" of the adult. To the ganglia which innervate the cheliceræ, the term "mid-brain" is applied; the five next pairs are called the "hind-brain," and the next pair the "accessory brain." These terms indicate the homologies which Dr. Patten sees between the brain of *Limulus* and that of the Vertebrata, claiming that in the nervous system of the King-Crab fresh support is to be found for his startling theory of the arachnid ancestry of the back-boned animals. The front wall of the cephalic lobes passes downwards into the cavities of a pair of semicircular lobes, identified by Dr. Patten with the infundibulum of the vertebrate brain. From these arise the roots of the nerve of the median eyes, which are compared to the pineal eye of vertebrates. Correspondences are also found between the olfactory organs of *Limulus* and of vertebrates, specially lampreys. Dr. Patten, indeed, states that the nervous

[3] NAT. SCI., vol. i., p. 524.

system of the adult King-Crab is remarkably distinct in appearance from that of any other arthropod, and "shows a profound structural similarity to that of the vertebrates." In order to see this, one must "tear off the deceptive arthropod mask that disguises *Limulus*." The true value of Dr. Patten's homologies can only be estimated by students of the vertebrate brain. But more evidence will be required to convince most naturalists that the many profound structural distinctions between arthropods and vertebrates do not point to a wide divergence of origin. In all arthropods the œsophagus pierces the nervous system. Dr. Patten suggests that in the primitive arthropod ancestor of vertebrates the œsophagus "broke through the narrow band of nerve-tissue in front of it." But, unfortunately, in *Limulus*, which he regards as the nearest living representative of this ancestor, the nerve-tissue in front of the œsophagus is not a narrow band, but forms the great cephalic lobes; and so, if this explanation is to be accepted, the correspondences between these lobes in *Limulus* and the vertebrates must be homoplastic, and not homologous.

Dr. Patten gives interesting details of the structure of the sense-organs of *Limulus*. Sensory spines on the joints of the legs are covered with tubular openings, each containing a chitinous tubule in connection with a single elongate nerve-cell. These have a tasting function. In the organ of smell are found clusters of large cells surrounding a multipolar ganglion-cell, connected with a chitinous tube ending near the outer surface.

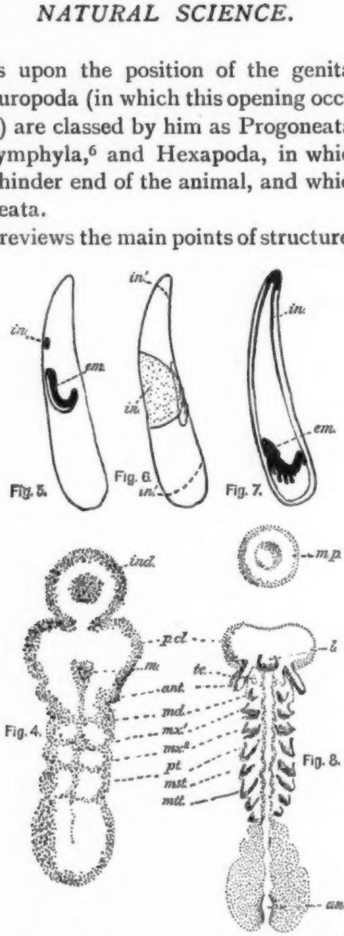
At the end of his paper, Mr. Kingsley reviews the question of the systematic position of *Limulus*. In a tabulated statement, he instances but six points in which its development and adult structure agree with those of the crustaceans, while the points of agreement with the arachnids number twenty-eight. He joins *Limulus* with the Eurypterids as a sub-class Gigantostraca forming, with the sub-class Arachnida, the class Acerata. With such strong confirmation of its arachnid affinities, most naturalists will prefer to call *Limulus* simply an arachnid. The association of the Eurypterids with the same class is justified by the researches recently summarised for us by Mr. Laurie.[4] But the Trilobites, for some time past considered as related to these forms, must probably be restored to the Crustacea since the discovery of their antennæ.[5]

Mr. Kingsley proceeds to the discussion of the classification of the Arthropoda generally. The Acerata and Crustacea form a sub-phylum Branchiata. The sub-phylum Insecta includes classes Hexapoda and Chilopoda while the Diplopoda form a separate sub-phylum. This view, that the centipedes are more nearly related to the true insects than to the millipedes, and that the Myriapoda must therefore be considered an unnatural group, has been put forward before, but has lately been elaborated also by Mr. Pocock (5) who

[4] NAT. SCI., vol. iii., p. 124. [5] NAT. SCI., vol. iii., p. 162.

lays special stress upon the position of the genital opening. The Diplopoda and Pauropoda (in which this opening occurs in the anterior region of the body) are classed by him as Progoneata, in opposition to the Chilopoda, Symphyla,[6] and Hexapoda, in which the generative duct opens at the hinder end of the animal, and which are accordingly called Opisthogoneata.

Mr. Kingsley reviews the main points of structure of the Diplopods,



FIGS. 5-7.—Embryos of *Xiphidium*. *em*. embryo. *in*. indusium. *in'*. furthest extension of indusium. FIG. 4.—Young embryo of *Xiphidium*. FIG. 8.—Embryo of *Anurida*. *ind*. indusium. *mp*. micropyle. *p.cl*. procephalic lobes. *m*. mouth. *l*. labrum. *ant*. antennæ. *tc*. tritocerebral appendage. *md*. mandibles. mx^1. mx^2. maxillæ 1 and 2. *pt*., *mst*., *mtt*. thoracic segments. *an*. anus. [After Wheeler.]

Chilopods, and true Insects, and finds further support for the association of the two latter groups in opposition to the former, in the correspondence of the pairs of jaws in centipedes and insects, and the coalescence of the somites in pairs in the millipedes. The systematic position of the Pauropoda, Pycnogonida, Trilobites, Tardigrada, and Malacopoda (*Peripatus*) is considered uncertain by

[6] According to some observers, however, the genital opening in the Symphyla (Scolopendrella) is situated in the fourth body-segment. Nevertheless, these animals must be nearly related both to the Chilopoda and the Thysanura.

Mr. Kingsley. Indeed, he considers it doubtful if the latter animals should be regarded as arthropods, pointing out that their serial nephridia, muscular pharynx, generally unstriated muscle-fibre, eyes, and pre-oral antennæ point to their relationship with the Chætopod worms. However, their reduced cœlome, heart and pericardium, tracheæ, and jaws will probably induce most naturalists to retain them as primitive arthropods.

While Mr. Kingsley has thus increased our knowledge of the development of *Limulus*, another American investigator, Dr. W. M. Wheeler, has (6) made a valuable contribution to the embryology of insects. His researches have been principally carried out upon a species of *Xiphidium*, an orthopterous genus belonging to the family of the long-horned grasshoppers (Phasgonuridæ).[7] The females of these insects lay their eggs in the galls produced on willows by midges (*Cecidomyia*). The eggs of a grasshopper of a nearly related genus (*Orchelimum*), a cricket (*Gryllus*), a "praying-insect" (*Stagmomantis*), and a marine collembolan (*Anurida*) were also studied.

The process of gastrulation is described, and confirms Cholodkowsky's researches on the cockroach and Graber's on *Stenobothrus* in showing that this process in the Orthoptera corresponds more closely than had been supposed with what occurs in the higher groups of insects. A structure of great interest observed by Dr. Wheeler in the development of the long-horned grasshoppers, is the indusium. This organ, which seems not to have been before noticed in the embryo of any winged insect, arises as a circular thickening of the blastoderm in front of the head (Fig. 4). While the embryo moves through the yolk, from the ventral to the dorsal aspect of the egg (Fig. 5) the indusium increases in size until it has assumed a saddle-shaped form, covering the greater part of the egg's surface (Fig. 6). A layer, corresponding to the amnion of the embryo, is formed within the serosa, over the indusium. Before hatching, the embryo in its growth comes again to the original ventral aspect of the egg (Fig. 7) absorbing the yolk, while the indusium becomes reduced to a cap of cells at the apex of the egg. Dr. Wheeler considers the indusium in these grasshoppers to represent the micropyle observed in embryos of the Poduridæ, and he gives a figure of the embryo of *Anurida* (Fig. 8) to confirm this view. He would also compare the structure with the dorsal organ of Crustacea, the primitive cumulus of spider-embryos, and the embryonic sucking-disk of certain leeches.

The antennæ of the insect embryos examined are stated by Dr. Wheeler to arise behind the mouth, and are so figured (Figs. 4, 8) thus confirming Cholodkowsky's observations upon the cockroach.[8] They are innervated from the deuto-cerebrum or first post-oral nerve-mass. The segment of the trito-cerebrum (the ganglion next behind) bears a pair of evanescent appendages in the embryo of *Anurida* (Figs. 8, *tc.*). With regard to the hindermost appendages of the

[7] Locustidæ, auct. [8] NAT. SCI., vol. i., p. 281.

body, Dr. Wheeler brings forward evidence to support the accepted view that they are utilised in connection with the reproductive opening.

Dr. Wheeler's observations upon the origin of the germ-cells confirm, on the whole, the results of Dr. Heymons with *Phyllodromia*,[9] except that doubt is thrown upon their very early differentiation as described by the latter observer. They have now been noticed in all but two of the abdominal segments of embryo insects, recalling very strongly the condition in worms. Dr. Wheeler's researches on the origin of the genital ducts confirm the view that they are modified nephridia. A peculiar mass of cells beneath the œsophagus, developed from the mesoderm of the trito-cerebral somite, is thought by Dr. Wheeler to be a vestigial nephridium, and, accepting the homology of this segment with the antennal segment of the Decapod Crustacea, to represent the green gland of a crayfish. This homology of the segments will bring the antennæ of insects into line with the crustacean antennule, and make the mandibles in Crustacea, Arachnida, and Insecta correspond. Dr. Patten, however, insists (4) that no segments have been suppressed in either insects or arachnids, and that the antennæ of the former correspond with the cheliceræ of the latter; but it seems impossible that all the recent describers of vestigial appendages can be mistaken.

With these contributions to the embryology of insects, it is well to record some recent memoirs upon their development after hatching. Professor Miall (7) has discovered the larva and pupa of a genus of Crane-fly (*Dicranota*) whose metamorphosis had been previously unknown. The grubs of the "Daddy-long-legs" (*Tipula*), belonging to the same family, are only too well-known as the "leather-jackets," which often devastate the roots of corn and grass crops. The larva of *Dicranota*, however, is a flesh-feeder; it lives in gravel and mud at the bottom of streams, and preys upon the well-known red worm, *Tubifex*. The head of the larva is small, and can be retracted within the thorax. The third to seventh abdominal segments bear pairs of fleshy legs with circles of hooks at the end, recalling the claspers of moth-caterpillars; the ninth (hindmost) segment carries three pairs of appendages, of which the posterior are long, and contain tracheæ. When the head is retracted, the brain, with the subœsophageal and prothoracic ganglia, is found in the mesothoracic segment. The alimentary canal shows adaptation to the carnivorous habit, being straight, and wanting the diverticula found in the grubs of *Tipula*. As in tipulid larvæ generally, there is but one pair of spiracles, situated on the back of the hindmost segment, which is also provided with tracheal gills, so that the grub can breathe by thrusting its tail either into air or water. A well-developed tracheal system provides for the storage of oxygen. The male generative organs develop very early, and ripe spermatozoa were observed in a larva not full-grown.

The pupa lives in damp earth, and breathes through a pair of

[9] NAT. SCI., vol. i., pp. 54, 55.

"respiratory trumpets" on the prothorax. The air is admitted to these through a series of small oval apertures, fine enough to keep out water or dirt, if they are not closed (as may, perhaps, be the case) by a transparent membrane. The abdominal segments bear dorsal plates with spines, by means of which the pupa makes its way out of the ground, before the fly emerges; ventral pro-legs, corresponding to those found in the larva, assist in this function.

The structure of the stigmata of the grub of the Common Cockchafer, as described by Herr Boas (8), recall the arrangement of the respiratory trumpet of the *Dicranota* pupa. The ordinary opening of an insect stigma is found to be closed in this larva, and the insect takes in air through minute pores in the "sieve-plate" surrounding the normal aperture. In both cases we see the adaptation to an underground life.

The highly interesting pupa of a minute moth (*Micropteryx*) has been lately described by Dr. Chapman (9). This pupa lives in a very strong cocoon, several inches underground. It is remarkable among lepidopterous pupæ in possessing a well-developed labrum, and mandibles which Dr. Chapman (allowing for the relative sizes of the insects) compares to those of a stag-beetle! As is well-known, these organs are usually reduced to the merest vestiges in moths and their pupæ. In the present case, the obvious use of these powerful jaws is to effect the escape of the pupa from its buried cocoon, before the emergence of the moth. The arrangement recalls what occurs in the Caddis-flies, and is another strong argument in favour of the primitive position of the Micropterygidæ among Lepidoptera, the wing-neuration having already led to the acknowledgment of their affinities with the Trichoptera. Yet another fact which tells the same tale is that the pupa seems entirely incomplete (the limbs are not soldered to the body) and the moth escapes through a simple dorsal slit—an arrangement hitherto unknown among moths according to Dr. Chapman.

REFERENCES.

1. **Lankester, E. Ray.**—Limulus an Arachnid. *Quart. Journ. Micr. Sci.*, vol. xxi., 1881.
2. **Kingsley, J. S.**—The Embryology of Limulus. *Journ. Morphology*, vol. vii, 1892, pp. 35-68, pls. v., vi.; vol viii., 1893, pp., 195-268, pls. x.-xiii.
3. **Kishinouye, K.**—On the Development of *Limulus longispina*. *Journ. Coll. Sci. Univ. Jap.*, vol. v., 1891.
4. **Patten, W.**—On the Morphology and Physiology of the Brain and Sense-Organs of Limulus. *Quart. Journ. Micr. Sci.*, vol. xxxv., 1893, pp. 1–96, pls. 1–5.
5. **Pocock, R. I.**—On the Classification of the Tracheate Arthropoda. *Zool. Anz.*, vol. xvi., 1893, pp. 271-275.
6. **Wheeler, W. M.**—A Contribution to Insect Embryology. *Journ. Morphology*, vol. viii., 1893, pp. 1-160, pls. i.-vi.
7. **Miall, L. C.**—*Dicranota*; a Carnivorous Tipulid Larva. *Trans. Ent. Soc. Lond.*, 1893, pp. 235-253, pls. x.-xiii.
8. **Boas, J. E. V.**—Ueber die Stigmen der *Melolontha* Larva. *Zool. Anz.*, vol. xvi., 1893, pp. 389-391.
9. **Chapman, T. A.**—On a Lepidopterous Pupa (*Micropteryx purpurella*) with functionally active Mandibles. *Trans. Ent. Soc.*, 1893, pp. 255-265.

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IV.

Note on the Evolution of the Scales of Fishes.

MUCH has been written by those who have studied the minute structure of fish-scales, concerning their primitive nature and mode of origin. It is generally admitted that the earliest hard parts appearing in the skin of fishes, were merely isolated calcified points or papillæ, such as those in which the tubercles of sharks and skates arise; and that all the later types of scales and plates are only the result of the fusion and elaboration of these fundamental structures. Palæontology, too, specially favours this idea; and an elaborate memoir just published by Dr. Rohon (3) shows more clearly than ever how large a majority of the fragments of dermal armour of chordate animals in the Upper Silurian rocks are almost identical in structure with the comparatively simple skin tubercles of the sharks and skates.

There is, however, another aspect of the subject which seems to have been less studied, and to which it is now possible to make one more small contribution. We refer to the question of the original character and subsequent phases of evolution of the typical overlapping scales of the trunk of ordinary fishes. Professor Ryder has inferred (4), from theoretical considerations, that these scales must have been originally disposed round the body in a series of rings corresponding to the successive plates of muscle; and he attempts to show, by an argument from mechanics, that they must have been at first rhombic in shape, in consequence of the direction of the strains arising from the working of the muscles during motion. It is obvious that the only proof of the theory can be obtained from Palæontology; and we propose in this brief note to summarise a few new or little-known facts bearing upon the subject.

Perhaps the simplest form of squamation met with in any fish-like organism is that of the Lower Palæozoic *Cephalaspis* and its allies, in which (as Professor Lankester first remarked) each segment of muscle seems to be surrounded by a distinct ring of six or seven scales; this ring being overlapped by the one immediately in front and overlapping that next behind (2, 5). Towards the extremity of the tail in *Cephalaspis*, however, where the motion is much greater than in the rest of the trunk, each of these rings is subdivided into a set of comparatively small rhomboidal scales—an arrangement

decidedly suggestive of the truth of Professor Ryder's theory of the effect of mechanical strains.

Among undoubted fishes it is not easy to discover any facts particularly apposite to the question under consideration in the groups of Dipnoi and Fringe-finned "Ganoids"; but it seems possible to turn with more satisfaction to the higher "Ganoids" of the sub-class Teleostomi. Here it is quite evident, in a general way, that as the fishes become higher in organisation—become specialised—the scales are more deeply overlapping, thinner, and almost or regularly cycloidal. We can now even quote instances in which the anterior part of the trunk is covered by typical quadrangular ganoid scales, united by a peg-and-socket articulation; while the base of the tail of the same fish is enveloped by deeply-overlapping thin rounded scales, which would be typically "cycloid" were it not for the presence of a few remnants of superficial enamel.

Such an instance is a deep-bodied fish related to the European Liassic genus *Dapedius*, obtained from the Hawkesbury Formation of New South Wales and shortly to be described under the name of *Aetheolepis*. Typical examples of its scales are shown in the accompanying figures. Those of the anterior series, as shown by the

Scales of *Aetheolepis* from Hawkesbury Formation, New South Wales.

drawing to the left, are thick and rhombic with well-developed peg-and-socket articulation; while on the caudal region all the scales are very thin and much overlapping, and they gradually degenerate backwards in the manner here indicated. The specimens are not sufficiently well-preserved to admit of the making of microscopic sections; but it is probable that the hindermost scales are destitute of bony tissue, and the traces of enamel are merely a few isolated tubercles. *Aetheolepis*, in fact, so far as its scales are concerned, belongs in its anterior half to the "order Ganoidei" of Agassiz, while posteriorly it almost exactly enters the "order Cycloidei" of the same author.

There is a tendency to the same kind of scale-arrangement also in a fish from the English Lias, apparently of the genus *Endactis;* and from both instances it may probably be inferred that the cycloidal scales have resulted from the modification of the thick quadrangular

scales by the mechanical conditions in the comparatively mobile caudal region where they are found.

It is well known that even in ordinary ganoid fishes with rhombic scales, their peg-and-socket union is almost always wanting on the tail, as if to ensure greater freedom of motion. So far as the present writer is aware, however, no case has hitherto been noticed in which firmly-united quadrangular scales are fixed at their upper and lower borders by more than the peg and socket. It is, therefore, of much interest to record that the scales of the Pycnodont genus *Mesturus* (from the Bavarian Lithographic Stone and the English Oxford Clay) are joined together above and below by a deeply dentated, interlocking suture, exactly as observed in certain scales of crocodiles. *Mesturus*, indeed, must have had an almost inflexible scale-armour.

If further proof were required that rhombic scales in the Palæozoic fishes are more primitive than deeply overlapping cycloidal scales, we need only refer to the case of the Palæoniscidæ. In this group the fishes with cycloidal scales always retain the thick rhombic ones on the upper lobe of the tail, however much the aspect of the trunk-squamation itself may have changed (1). It is therefore curious to find that among the Devonian fringe-finned ganoids, those with the most primitive fins (Holoptychiidæ) have the scales round and deeply overlapping, while many of those with more specialised fins (Osteolepidæ) have the squamation rhombic. At the same time, it must be remembered that the rhombic-scaled *Megalichthys* of the Coal-measures gradually passes into the round-scaled *Rhizodopsis* of the same age, the inner rib of each scale then degenerating into a small tubercle; and some of the round scales of the Devonian fishes show this inner tubercle, which is likely to have arisen in the same manner.

REFERENCES.

1. **Fritsch, A.**—Fauna der Gaskohle und der Kalksteine der Permformation Böhmens, vol. iii., pt. 2, 1893.
2. **Lankester, E. R.**—The Fishes of the Old Red Sandstone of Britain. Part i., *Mon. Pal. Soc.*, 1870.
3. **Rohon, J. V.**—Die Obersilurischen Fische von Oesel. *Mém. Acad. Imp. Sci., St. Pétersbourg*, vol. xli., no. 5, 1893.
4. **Ryder, J. A.**—On the Mechanical Genesis of the Scales of Fishes. *Proc. Acad. Sci. Philad.*, 1892, pp. 219–224.
5. **Woodward, A. S.**—Catalogue of the Fossil Fishes in the British Museum. Part ii., 1891.

A. Smith Woodward.

V.

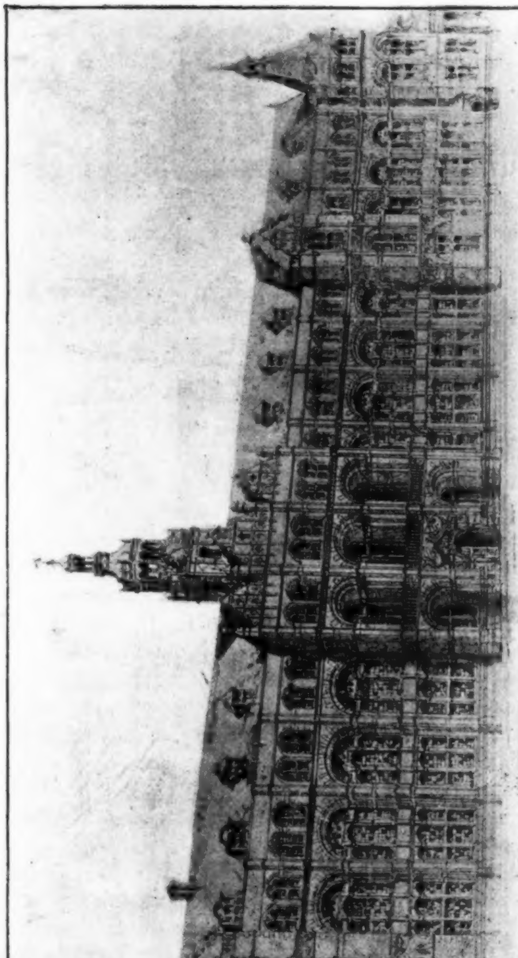
The Sedgwick Museum, Cambridge.

WHEN the question of a memorial to Professor Sedgwick came to be considered, it was generally agreed that nothing could be more appropriate than a Museum to contain the collections which had been so largely made during the fifty-five years of his Professorship, and which even then (1873) were too extensive for the building which they still occupy. For this purpose a sum of money, which now amounts to £23,000, was quickly subscribed.

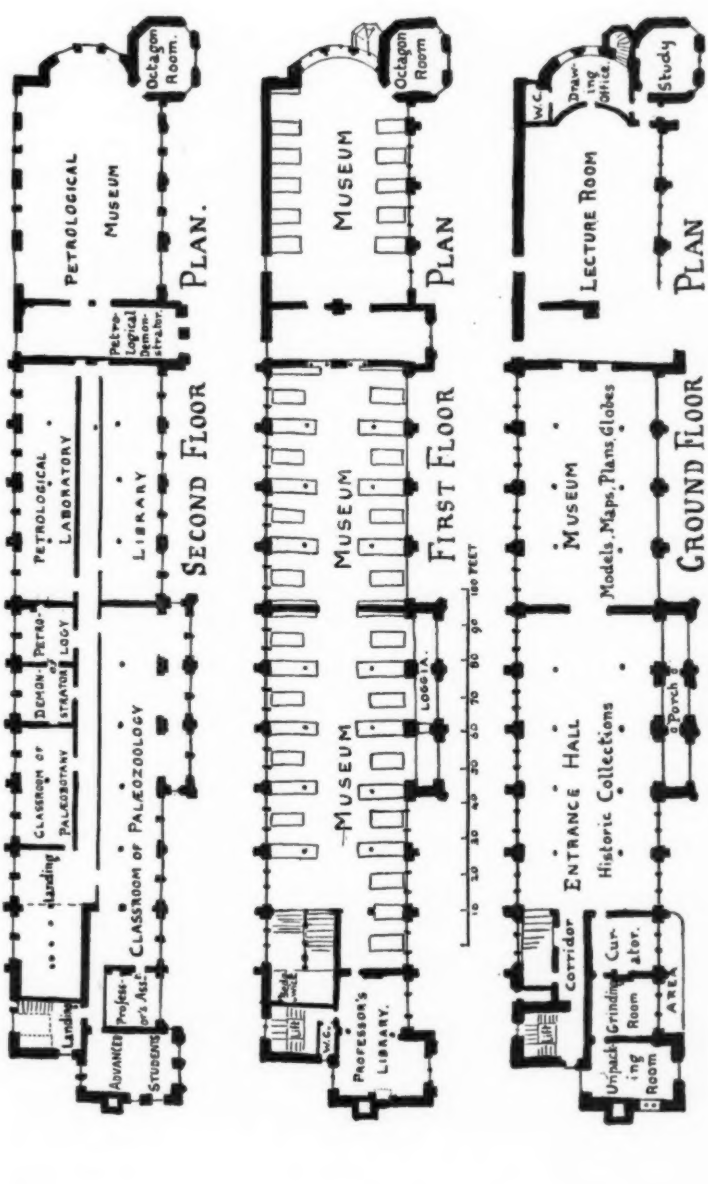
Several syndicates have been appointed by the University from time to time to carry out this object. But no real advance was made until 1891, when the site was fixed upon as that part of the Old Botanic Gardens which faces Downing and Pembroke Streets, and extends from Corn Exchange Street to near the Chemical Laboratory. This position will be most convenient both for teachers and students, since all the other departments of Science have their museums and laboratories close at hand. Another Syndicate was appointed on February 4, 1892, to prepare plans and obtain estimates for the building. The services of the eminent architect, Mr. T. G. Jackson, A.R.A., were obtained; and his plans, together with the report of the Syndicate, were presented to the University on November 22, 1892, and after some slight modifications were accepted by the Senate on May 4, 1893.

The perspective elevation and floor-plans are shown in the accompanying illustrations. The materials to be used in the construction are red brick and Clipsham stone (Lincolnshire Oolite). The length of the building will be 304 feet, and the breadth 44 feet (outside measurement); the main wall will be set back 10 feet from the street, and the projecting portions 4 feet. There will be three floors in addition to cellars and attics.

On the ground floor will be the entrance-hall, containing the original Woodwardian and other historic collections; to the right will be a room for models, maps, sections, etc., and beyond this a lecture-room; to the left will be the Curator's room and other offices. At the north-west corner will be the principal staircase. The first floor will be devoted entirely to the Museum of Stratigraphical Palæontology, with the exception of a room at the west end for the Professor's library. This museum will be divided by upright cases,



THE PROPOSED SEDGWICK MUSEUM, CAMBRIDGE.



Plans of Proposed Sedgwick Museum, Cambridge.

placed between the windows, into compartments, in each of which a table case will be placed. The third floor will be occupied by laboratories for Palæontology and Petrology, by private rooms for lecturers and demonstrators, and by the Museum of Petrology.

The two lower floors will be lighted by long windows reaching up to the second floor-level; the top floor will be lighted by smaller and more numerous windows.

The laboratories are placed on the second floor in order to secure the best light. This has made it necessary to place two rows of pillars in the lower floors for support; in the main museum they will pass through the middle of the upright cases, and will consequently be quite inconspicuous. At the head of the first flight of stairs there will be a statue of Professor Sedgwick. The eastern part of the site assigned to the Museum is at present occupied by the medical school, and as this cannot yet be accommodated elsewhere, it is proposed to build first a part of the Museum on the ground which is free.

Henry Woods.

VI.

Recent Explorations of the Maltese and Sicilian Caverns.

SOME interesting progress has recently been made in investigating the bone-caves of Malta and Sicily. It has long been a matter of common belief that these islands are the remnants of one of the old land barriers connecting Europe with Northern Africa during at least part of the Pliocene and Pleistocene periods; and a detailed study of the animal remains met with in the fissures and caverns is thus one of the foremost importance. Not only is it possible to recognise the mingling of northern and southern animals, and the apparent effect of isolation upon them before their complete extinction as the feeding-area became more and more reduced by subsidence; but it also seems likely that some idea of the nature of recent physical changes in the region in question can be obtained from a comparison of the sequence of deposits in the various localities examined. The work in Malta has been carried on by Mr. John H. Cooke, with the aid of a grant from the Royal Society of London (7); the new researches in Sicily are those of Dr. Hans Pohlig, based upon a large collection of bones in the Palermo Museum from the Cavern of Pontale, at Carini (10).

The bone-caves of Malta were discovered so long ago as the middle of the seventeenth century (1), and they have long been well-known through the explorations and researches of the late Rear-Admiral Spratt (11), Professor Leith Adams (2–5), Dr. Hugh Falconer (8), and Dr. George Busk (6). They have yielded some dwarf elephants, described under the names of *Elephas melitensis*, *E. falconeri*, and *E. mnaidriensis*, and a dwarf hippopotamus (*H. pentlandi*). They have also furnished evidence of a so-called gigantic dormouse (*Myoxus melitensis*), some large land-tortoises (3, 4), and various birds (9). Mr. Cooke's researches, therefore, are for the most part only an independent verification of results already obtained; but, at the same time, he has succeeded in making one or two striking additions to our knowledge of the extinct fauna in question. The principal specimens obtained have been placed in the British Museum, and a detailed report on these fossils by Mr. A. S. Woodward is appended to Mr. Cooke's account of his results.

Attention has been chiefly confined to one cavern in the Har

Dalam Gorge, near Marsa Scirocco Bay, where Spratt and Adams accomplished so much. It is situated 500 yards from the shore, and its mouth is now 40 ft. above the bed of the small stream which, in rainy weather, flows through the gorge. There is evidence everywhere of former torrential rains, where all is now comparatively parched; and Mr. Cooke considers that no other phenomenon could have filled the caves and fissures as he finds them. In most parts the Har Dalam Cave was filled to a height of within 2 ft. of the roof, and one of the principal sections of the contents showed the following succession of layers:—(i.) Unstratified surface *débris*, 6 in.; (ii.) Red clayey loam, 3 ft., with *Hippopotamus*, *Cervus*, and pottery; (iii.) Unfossiliferous black earth, 4 in.; (iv.) Dark red plastic clay, 1 ft. 6 in., with *Hippopotamus*; (v.) Reddish clay, 1 ft., with *Hippopotamus* and *Cervus*; (vi.) Unfossiliferous yellow plastic clay, 2 ft. In one place a human bone was found at about the base of layer iii.; and layer v. also yielded the first evidence of extinct carnivorous animals discovered in Malta—a portion of mandible with teeth of a bear, and one tooth of a canine quadruped as large as a wolf.

The discovery of these carnivora in the Maltese caverns is of great interest, because gnawed bones have already been noticed; but it is probable that still others remain to be found, notably the lion and hyæna. The jaw of the bear, moreover, cannot be specifically determined—cannot be definitely assigned either to any extinct animal, to the brown bear, the grisly, or to those of Northern Africa; can only be distinguished with certainty from our cave bear. As for the canine, a single tooth is insufficient to prove whether or not it belongs to a domestic dog.

Still more interesting is the discovery of a great number of bones of a small deer, mostly identified with the diminutive race of the common stag met with in Northern Africa and known as the Barbary Deer. The Fallow Deer may also have been present, but there are no characteristic fragments. One superficial layer in the Har Dalam cave consisted almost entirely of these remains in stalagmite, belonging to animals in all stages of growth, perhaps even from the unborn fœtus onwards. The adults vary much in size, but the largest complete antler measures only about 2 feet in length.

It is worthy of notice, in reference to Dr. Pohlig's recent memoir on the Cave of Carini, that the same form of dwarf deer is also now recognised in Sicily. Dr. Pohlig, however, gives a new sub-specific name to the animal, terming it *Cervus* (*elaphus*) *siciliæ*; and his nomenclature for the associated species is not altogether such as will commend itself to many zoologists.

The chief advance made by Dr. Pohlig, indeed, consists in his adding to the known Pleistocene fauna of the Sicilian area this small deer and the dwarf elephant commonly known as *Elephas melitensis*. Of the latter, even finer specimens have been discovered at Carini than those obtained from Malta; and Dr. Pohlig is now able to

describe the whole skull for the first time. As the result, he is more than ever convinced of the correctness of his opinion, expressed some years ago, that all the dwarf Maltese elephants described by Falconer, Busk, and Adams are merely a stunted race of the typically European *Elephas antiquus*. He even goes further, and concludes that the latter elephant wandered in Pleistocene times as far south as India, being represented in the Narbada Valley by the so-called *E. namadicus*.

Besides the bones of animals in the new Sicilian cave, which are now described as including remains of such familiar European species as *Bos primigenius* and *Bison priscus*, there are also some traces of man, in the form of rude pottery and stone implements. There is, however, no very clear evidence as yet to indicate man's relationship to the extinct fauna; and we refrain from quoting Dr. Pohlig's table of the succession of episodes supposed to be proved by the series of deposits he has examined. All these new facts will some day be of great service when the time for broad generalisations as to the recent changes of land and sea in the Mediterranean area is at hand; at present it seems futile to base speculations on isolated phenomena.

REFERENCES.

1. **Abela.**—Della Descrittione di Malta, 1647.
2. **Adams, A. L.**—Natural History and Archæology of the Nile Valley and Maltese Islands, 1870.
3. ————————.—On Fossil Chelonians from the Ossiferous Caves and Fissures of Malta. *Quart. Journ. Geol. Soc.*, vol. xxii., 1866.
4. ————————.—On Gigantic Land-Tortoises and a small Fresh-water Species from the Ossiferous Caverns of Malta. *Ibid.*, vol. xxxiii., 1877.
5. ————————.—On the Dentition and Osteology of the Maltese Fossil Elephants, being a Description of Remains discovered by the Author in Malta between the years 1860 and 1866. *Trans. Zool. Soc.*, vol. ix., 1874.
6. **Busk, G.**—Description of the Remains of three extinct Species of Elephant, collected by Captain Spratt, C.B., R.N., in the Ossiferous Cavern of Zebbug, in the Island of Malta. *Trans. Zool. Soc.*, vol. vi., 1867.
7. **Cooke, J. H.**—The Har Dalam Cavern, Malta, and its Fossiliferous Contents, with a Report on the Organic Remains, by A. S. Woodward. *Proc. Roy. Soc.*, 1893.
8. **Falconer, H.**—Palæontological Memoirs, edited by Murchison.
9. **Parker, W. K.**—On some Fossil Birds from the Zebbug Cave, Malta. *Trans. Zool. Soc.*, vol. vi., 1867.
10. **Pohlig, H.**—Eine Elephantenhöhle Siciliens und der erste Nachweis des Cranialdomes von *Elephas antiquus*. *Abhandl. k. bay. Akad. math.-phys. Cl.*, vol. xviii., 1893.
11. **Spratt, T. A. B.**—On the Bone-caves near Crendi, Zebbug, and Melliha, in the Island of Malta. *Quart. Journ. Geol. Soc.*, vol. xxiii., 1867.

SOME NEW BOOKS.

AUSTRALASIA. Vol. i., Australia and New Zealand. Stanford's Compendium of Geography and Travel (new issue). By Alfred Russel Wallace, LL.D., D.C.L. 8vo. Pp. xvi., 505, maps, and illustrations. London: Stanford, 1893. Price 15 shillings.

"IN the present volume an attempt has been made to give a compact description of our great Australian Colonies, which should be useful to intending visitors or emigrants; and which will also be interesting to the general reader who may wish to become acquainted with the natural features and social condition of the Britain of the Southern Hemisphere." With the above words the author prefaces his volume, noting also that he has treated of the history and geology, the physical characteristics, customs, languages, and probable origin of the aboriginal inhabitants. Further information is given as to the history of Australian exploration and the special characteristics and productions of the several colonies as well as their more important industries. Prefixed to the general work is a list of works used in preparing the volume, which, though arranged without any regard for alphabetical order or date, will prove useful to the reader if he wishes to pursue his subject further, for the book is essentially one of reference, although readable enough in itself.

Dr. Wallace opens with the general subject, dealing with the definition and nomenclature of Australasia, showing how the area covered by the word has gradually been restricted by geographers until, at present, it is held to comprise only Australia and New Zealand, together with the large islands as far north as New Guinea and the New Hebrides. He, however, holds it to include the islands of the Malay Archipelago as well, and prefers to retain the word Australasia, rather than Oceania, because the former indicates the true relation of the group to the great land-mass of which it forms a southern prolongation.

The geographical and physical features of Australasia are unique, and are thus sketched by Dr. Wallace. In the west, the Malay archipelago, comprising the largest islands in the world (Australia excepted), is unsurpassed for the luxuriance of its vegetation, as well as for the variety and beauty of its forms of animal life. Further to the east are the islands of the Pacific, remarkable for their numbers and their beauty; while to the south is Australia, as unique in its physical features as it is in its singular forms of vegetable and animal life. Still further south lies New Zealand, almost the antipodes of Britain, but possessing a milder climate, and a more varied physiography. Comprised thus between the northern tropic and the 40th degree of south latitude, this land-mass possesses as tropical a climate as Africa, while, owing to its being so completely oceanic, and to its wide exterior, it presents diversities of

physical features and of organic life hardly to be found in any of the other divisions of the globe, Asia, perhaps, excepted.

The most striking contrasts of geological structure are exhibited by the coral islands of the Pacific, the active volcanoes of the Malay Archipelago, and the ancient rocks of New Zealand and Tasmania. The most opposite aspects of vegetation are presented by the luxuriant forests of Borneo and New Guinea and the waterless plains of Central Australia. In the Sunda Islands we have an abundance of all the higher and larger forms of mammalia; while farther to the east, in Australia and the Pacific Islands, the absence of all the higher mammals is so marked as to distinguish these countries from every other part of the world. When the land-surface is so completely broken up into islands we cannot expect to find any of the more prominent geographical features which characterise large continents. There are no great lakes, rivers, or mountain ranges. The only land-area capable of supporting a great river is exceptionally arid, yet the Murray of Eastern Australia will rank with the largest European rivers, its basin having an area about equal to that of the Dnieper. Mountains are numerous, and are much higher in the islands than in Australia itself. In such remote localities as Sumatra, Borneo, the Sandwich Islands, and New Zealand, there are mountains which just fall short of 14,000 feet. In New Guinea they probably exceed this altitude, if, as reported, the central range situated close to the equator is snow-covered; while in Australia itself the most elevated point is little more than half as high.

In studying the natural history of Australasia an accurate knowledge of the depths of the waters intervening between the several islands is of considerable importance, and Dr. Wallace provides some details which show that the depth of the seas is greatest near the larger land-masses in this region as in most others. For instance, close to the New Hebrides the soundings record 16,900 feet; between Sydney and New Zealand, 15,600 feet; and a little to the south-east of New Guinea, 14,700 feet. There is a comparatively shallow sea round the coasts of Australia itself, which gradually deepens, till at some 300 to 500 miles on the east, south, and west, the depth of 15,000 feet is attained. The sea connecting Australia with New Guinea and the Moluccas is rather shallow, with intervening basins of great depth. In the Banda Sea the line records 12,000 feet, in the Celebes and Sooloo Seas over 15,000 feet, and in the China Sea, west of Luzon, is a depth of 12,600 feet. Further westward the sea shallows abruptly, so that Borneo, Java, and Sumatra are connected with each other, and with the Malay and Siamese peninsulas, by a submarine bank rarely exceeding 200 or 300 feet in depth.

There are some five or six races of mankind in the area: Malays, Papuans, Australians, Polynesians, Tasmanians (now extinct), and the Negritos. With regard to some of these Polynesians, Dr. Wallace remarks that those inhabiting Samoa and the Marquesas are in no respects inferior to the average European, either in their complexion, physical beauty, or nobility of expression; and he laments that these higher tribes are all disappearing under the fatal contact of our much-vaunted civilisation. To this we venture to add our own regrets on the inevitable extermination of the fine race of Maories in New Zealand.

In the Zoology and Botany, Australia is characterised by possessing a number of peculiar forms, as well as by the absence of many which are common in almost every other part of the globe. The

mammalia are almost exclusively marsupial, the only other representatives of the group now living being the opossums of America. Of the birds, there are no familiar types, as vultures, pheasants, and woodpeckers, but such peculiar forms as honeysuckers, paradise birds, lyre birds, and cassowaries. The snakes and lizards, though numerous, are also singular.

In the plants the same peculiarities are to be seen. The Malayan flora is a special development of that which prevails from the Himalaya to the Malay Peninsula and South China. Further east, this flora intermingles with that of Australia and Polynesia. The Australian flora is highly peculiar, and very rich in species; while that of New Zealand is poor but very isolated. Special sketches of both faunas and floras are given in connection with each colony.

The geological relations of this portion of the world are undoubtedly with Asia. Dr. Wallace thinks that the exceedingly shallow seas connecting the islands of the northern area show that not only Java and Borneo, but even the Philippines formed a south-eastern extension of the Asiatic Continent in a comparatively recent period. The vegetable and animal life shows this still more clearly. But between this mass and that of New Guinea and Australia, we pass over deep seas and find ourselves among a set of animals for the most part totally unlike those of the Asiatic Continent, or any other part of the globe. The resemblances of these southern life-forms to the fauna of Europe during the Secondary period are very striking, and lead Dr. Wallace to say that it is generally believed that the countries they now inhabit have been almost completely isolated from other land-masses since the Oolitic period. The evidence derived from a study of New Guinea, the Moluccas, and the islands as far as Lombok in the north, and Tasmania in the south, goes to prove that Australia was formerly more extensive than it is at present. That this is clear as regards its eastern seaboard is proved by the Great Barrier Reef, whose coral walls still indicate the former limits of the coast-line in this direction. On the same coast, but further removed from the mainland, are some scattered islands, conspicuous among which is New Caledonia, and this is slowly sinking.

Australia must, therefore, says Dr. Wallace, be regarded as an ancient continent of the Secondary or early Tertiary period now gradually diminishing, and this phenomenon of subsidence is displayed in New Caledonia and in some other islands of the South Pacific Ocean. Dr. Wallace is careful to point out that it is now recognised that coral islands do not prove subsidence wherever they occur, but may, and frequently do, indicate areas of elevation at a recent period.

Passing now to the special chapters of the book, we find the present volume confined to two great divisions, (1) Australia, including Tasmania, and (2) the New Zealand group. Malaysia, Melanesia, Polynesia, and Micronesia will form the subject of Dr. Wallace's second volume.

Australia itself, as a whole, is first dealt with, subsequent chapters treating in turn of New South Wales, Victoria, South Australia, West Australia, Queensland, and Tasmania.

With regard to Australia as a whole, Dr. Wallace calls attention to the simple conformation of the land-mass, which rises generally from the coasts into elevated uplands in the interior. But the assumption that Australia forms a vast table-land, with elevated borders sloping towards the interior, must be taken with considerable qualification. The Australian highlands form no connected whole,

but are everywhere intersected by depressions, and a subsidence of 2,000 feet would convert the whole continent into a group of islands; though this, of course, is true of most other continents. A further peculiarity of these uplands is their distribution mainly along the coast, and skirting the interior where no extensive mountain-ranges have hitherto been discovered. The forbidding and desolate plains of the interior of Central and Western Australia are described, and attention is called to their peculiar vegetation (the "Mallee scrub" and the "Mulga scrub") and the extraordinary deficiency of water.

The river-system of the eastern half of the continent is compared with those of the Old and New worlds, and notes are given as to the excessive irregularities of droughts and floods. In the central and western portions streams appear in the wet seasons, but after a short time disappear in the sands; hence, while one explorer has found a total absence of water and herbaceous vegetation, another, arriving in the same region after one of the rare rainy periods, has been delighted with the running streams, luxuriant herbage, and abundance of animal life.

The climate is much less variable than might be supposed. It may be described as hot and dry, and on the whole healthy. The mean temperature at Melbourne is 58° Fahr.; at Sydney it is about 63°; at Adelaide it is slightly higher, while at Perth it is about the same. The extremes of heat are reached when the hot winds blow from the interior, the highest point yet recorded being the bursting of Captain Sturt's thermometer at 127° in the shade. The same traveller found a mean temperature of 100° Fahr. for three months on one occasion. The rainfall is heaviest at Sydney (50 inches), diminishing as one goes inland, while in the south at Melbourne it is 25 inches, and in Western Australia about 30 inches.

The chapters on the Botany, Zoology, and Geology, as one might expect from Dr. Wallace, are full and interesting. The geological map presents a mass of detail, and is generally effective, but one would like to have seen a more modern and precise word than "Trap" used, and the "Crystalline or Metamorphic" rocks not put down as Primary or Palæozoic. We fancy also that it will be news for some geologists to find Oligocene classed as Lower Tertiary, and Volcanic rocks under the head "Igneous or Plutonic."

Each division of Australia is treated in similar detailed fashion, but want of space forbids us from giving a general sketch of each.

New Zealand occupies the last 70 pages of the book, and receives a careful description, similar to that given to Australia. Dr. Wallace, however, is not quite correct in saying that the secluded and romantic waters of lake Taupo are furrowed only by the canoes of the natives, for there is an English settlement there, and we believe the ardent sportsman may now be conveyed by the more expeditious, if less picturesque, steam launch. We also rather doubt the magnificent spectacle of six geysers playing at once, as shown in the somewhat wooden cut of a view on the river Waikato (p. 418). A little contempt, too, seems to be bestowed on the great extinct birds in the sentence—No birds or reptiles have been found except such as are allied to forms still living on the island. But Dr. Wallace refers more kindly to these important relics of the past on p. 446, and our readers have been kept well up-to-date as to recent discoveries and observations on moas in the pages of this Journal.

Taken as a whole, the book is full of interest, is generally well

illustrated, both by woodcuts and maps, and will prove an exceedingly valuable book of reference. Some few slips are found here and there, and some omissions of information to be found in the most recent publications; but Dr. Wallace may well be excused, for in the compilation of books such as these much time is occupied, and no one regrets more than the authors the impossibility of putting in more facts.

THE ZAMBESI BASIN AND NYASSALAND. By Dan J. Rankin. 8vo. Pp. vii., 277, with 3 maps and 10 full-page illustrations. London: William Blackwood and Sons, 1893.

WE must confess to considerable disappointment with this book, for we had expected much and have got but little. The author is known to be a man of considerable literary ability and a first-rate Arabic scholar. He has spent much time in East Africa, and knows the district and its natives well, while his work in connection with the opening of the mouth of the Chindi to trade has had an important influence on the commercial prospects of the whole of the Zambesi basin. Nevertheless, there is very little of permanent value in the book. The flora of the district is barely mentioned; the only information about the fauna consists of a few accounts of hippopotamus hunting, and the inevitable, but amusing, crocodile tragedies, which play in Africa the part of the "grizzly" in the stories of our imaginative Western cousins. This is the more unfortunate as the author seems to have met with some very queer beasts, such as the intrusive scorpions, which were so numerous in a steamer's saloon that they had to be dusted off; then there are the worms, which seem to thrive in the iron plates of the same steamer, and a brittle hippopotamus, both sides of whose head were smashed away by a blow on the jaw from only a 12-bore bullet. The book includes more than its title would lead one to expect, as one chapter is devoted to Mombasa, which is certainly far beyond the limits of either the Zambesi Basin and Nyassaland; the remarks on Mombasa, moreover, are disappointing, and as there is no fresh information in the chapter, we must conclude that the author's researches into the history of the early settlements of the Arabs have not been rewarded by new discoveries. This is much to be regretted, considering the anthropological importance of the subject. The author also gives a sketch of the scheme and objects of the International Flotilla Company, which hopes to establish communication from the mouth of the Zambesi to Cairo by the Nile, the great lakes, and the Shiré.

The book is extremely well printed and got up, many of the stories are amusing, and we cannot resist quoting one which illustrates the cuteness of mission companies when they do take to business. The author and two other Europeans once, at the extreme peril of their lives, saved a mission station by running the gauntlet down the Shiré, capturing and repairing the mission steamer which had been seized by the natives, and then working it back to Katunga. Apparently the only thanks they received for this plucky performance was *a bill for their passage.*

ELEMENTARY PALÆONTOLOGY. By Henry Woods, B.A., F.G.S. Crown 8vo. Pp. viii., 222. Cambridge Natural Science Manuals. Biological Science. General Editor, A. E. Shipley, M.A. Cambridge: C. J. Clay & Sons, 1893. Price 6s.

OUR chief quarrel with this little book is with its title. If, instead of naming it "Elementary Palæontology," the author had called it a

Rule of Thumb Guide to Invertebrate Zoology for the use of Examination Candidates in Geology, we should have had nothing to say against it. All that those gentlemen want is to be able to spot their fossils with a minimum of trouble and a maximum [?] of certainty; they reck naught of morphological niceties so long as they can "pip the examiner." To this goal Mr. Woods will prove an excellent guide, and that his goal is no nobler one is probably deplored as much by himself as it is by us. As to our own ideal, the curious—if such there be—will find it in NATURAL SCIENCE, vol. ii., p. 307.

We would willingly leave the book here, but as it is the first of a series issued under the auspices of no less a body than Cambridge University, it is only due to the Editor and his co-labourers that we should treat it with some seriousness. We hope, in the first place, that the other writers of elementary manuals will not use quite so many long words, at all events, without explaining them. Here the terms "isotropic silica" (p. 3), "optically biaxial" (p. 4), "siphonostomatous" (p. 10), "phylogeny" (p. 11), would make the ordinary undergraduate throw the book out of the window before he had finished the introduction. To judge from his definition of the Foraminifera, Mr. Woods has never heard of the student who was brought to a stand by a similar one. When his teacher said, "I suppose you don't know the meaning of *arenaceous*," he proudly replied, "Oh! yes. I have heard of arenaceous *foods*."

There is, as we have implied, far too much Zoology for a book that calls itself a "Palæontology." Under no circumstances can a palæontologist as such, much less a geologist, want to know anything about the nervous system of the Bryozoa or the renal organs of the Mollusca. The compilers of Zoological text-books have a right to prosecute Mr. Woods for poaching on their preserves.

The absence of finished pictures of specimens is a commendable feature, for such only help the lazy reader. Other writers in the series will do well to follow Mr. Woods' example, but it is to be hoped they will steer clear of his occasional habit of using a plural nominative with a single verb, *e.g.*, "The Porifera includes the Sponges." It would also have been an improvement had the name of some typical species, not necessarily the type species, been added to the descriptions of the genera. In the present state of Brachiopod nomenclature, for instance, it will take the student a few hours to determine what the author means by *Strophomena* and *Leptæna* respectively.

It is a pleasure to find the Pteropods at last removed from the Cephalopods to the Gastropods; but the account of the Cephalopods is no great advance on that of previous text-books. It is all very well for a teacher to be conservative; but there does come a time when one must either "mend or end." "The species of *Ammonites* . . . . differ so much from one another that they are now regarded as representing many distinct genera. . . . . But in an elementary work like the present it will be convenient to retain the old genus *Ammonites*." Long may the good old genus *Ammonites* remain—*in our text-books*! Seriously, what would Mr. Woods or anyone else think, if a writer were to substitute the word *Encrinus* for *Ammonites* in the above quotation? Anyhow, it is worse than absurd, after disposing of the various Families, not merely Genera, of Ammonitinæ in this manner, to devote a whole page to descriptions of the uncoiled Cretaceous forms, which are not genera at all.

Ammonites is described as "possessing two pairs of gills, two

pairs of auricles, and two pairs of kidneys," while other details of its anatomy are given. Of course, if this is the case, the author is perfectly justified in retaining it in an Order Tetrabranchiata, although in opposition to the views of recent writers. It is, however, to be hoped that the specimen from which these details have been determined will soon be adequately figured and exhibited before some learned society by preference, the Royal.

On the whole, the definitions and descriptions are fairly accurate and moderately clear, while the bibliography at the end should prove useful to English students; but is it not stretching a point to describe the calyx of *Apiocrinus* as "pear-shaped," when its shape really resembles that of a piece used in the game of draughts? Still, if there are slips of this kind, and we must admit that we have counted not a few, it is only because the author has attempted an impossible task. It is far more difficult to compile an accurate and intelligible elementary manual than it is to write an elaborate original monograph. Certainly, no one who has not done the latter should ever be encouraged to attempt the former.

F. A. B.

TEXT-BOOK OF GEOLOGY. By Sir Archibald Geikie, D.Sc., LL.D., F.R.S., etc. Third edition. Pp. 1,147. London: Macmillan & Co., 1893. Price 28s.

EIGHT years have elapsed since the second edition of this book was published, and the work accomplished during the interval has led to an increase of 155 pages in the volume. Nevertheless, its actual bulk is not perceptibly increased—the paper is excellent, and the illustrations, of which there are thirty-two more than in the last edition, are admirably printed. The author maintains the moderate uniformitarian doctrines which he has hitherto professed, remarking "that the few centuries, wherein man has been observing nature, form much too brief an interval by which to measure the intensity of geological action in all past time."

Throughout, the work has been revised where needful, and additional references are given to the latest sources of detailed information. On all matters relating to rocks and rock-structure, to the work of modern agents, and the appearances of the rocks in the field, the definitions and descriptions are most lucid. In the matter of palæontological succession and of the value of organic remains in correlating strata at a distance, the views of the author are not in harmony with those of advanced zonalists. If "strict contemporaneity cannot be asserted of any strata merely on the ground of similarity or identity of fossils," yet practical contemporaneity may in many cases be justly maintained, especially when a similar sequence of "zones" is found to characterise areas widely separated. Zonal subdivision and attempts at very minute correlation may, however, be carried to an extreme degree; and further research may justify the cautious attitude of the author, who, in comparing the rocks of distant countries, remarks, "all that we can safely affirm regarding them is, that those containing the same or a representative assemblage of marine organic remains belong to the same epoch in the history of biological progress in each area."

In the portions of the book relating to Stratigraphical Geology, large additions are made to the sections dealing with the pre-Cambrian and older Palæozoic rocks, and other sections are duly brought up to date by the insertion of new facts and further references. The book, however, is so well known, that we need say nothing more, except to

congratulate the author on the completion of his task—one which, considering its comprehensive character, must indeed have proved an immense labour; but which, for this very reason, is a signal service to Science.

Tables for the Determination of the Rock-forming Minerals. Compiled by Professor F. Lœwinson-Lessing, translated from the Russian by J. W. Gregory, B.Sc., F.G.S., with a chapter on the Petrological Microscope by Professor Grenville A. J. Cole, M.R.I.A., F.G.S. London: Macmillan & Co., 1893. Price 4s. 6d. net.

Many investigators who have not had the chance of proper training in a petrographical laboratory, and have had to gain their acquaintance with the methods by books, must have felt their lot a very hard one. Even when they have become fairly well practised in the branch of the microscopic mineralogy of rocks, the determinations in many cases are long and tedious, as classified diagnostic tables were still wanting. So far we had only the systematic description of minerals as they occurred in rocks, but they were classified according to their chemistry, and not by their microscopic characters. The above work admirably fills that gap, and now, after a few lessons in microscopical tactics, a student with a fair knowledge of mineralogy can start as a rock describer.

The original work appeared in Russian, a language to all intents and purposes beyond the knowledge of European and American scientists, and Dr. J. W. Gregory has made all petrographers his debtors for translating Professor Lœwinson-Lessing's book. Dr. Gregory had intended to add a chapter on the petrological microscope, but one of his multifarious duties called him to African exploration, so that his partially-finished chapter was placed in the able hands of Professor Grenville A. J. Cole, who has acted as the contributor of it to this joint work.

In the introduction we have a general outline of the methods to be employed. In the next chapter the main requisites of a petrographical microscope and their uses are described. In part II. of the book we have the tables. Minerals are divided for investigation into opaque, semi-opaque, and transparent, and under each the optical, chemical, and other tests are given. The transparent are divided into colourless and coloured. These groups are subdivided again, according to whether the mineral shows crystal outlines, crystalline grains, or grains in crystalline rocks. Table III. gives a classification of other morphological characters, such as tabular crystals, needles, broad tablets, flakes, filaments, or aggregates, while the presence of colour is again used to group the minerals. In table IV. the determination of the crystalline system under the microscope is treated of. This is followed in table V. by a classification of the rock-forming minerals according to their crystalline system. The book terminates by a table of minerals according to their optical signs.

Only one or two questionable statements attracted our attention, one being, "It is convenient to leave leucite in the prismatic system, which it resembles in form; it appears, however, to be really a monoclinic mineral which has acquired prismatic form by compound mimetic twinning." Most of us hoped that the interminable literature and ingenious contrivances of transcendental crystallographers to explain the optical anomalies of leucite were once for all finished, and that simple temperature strain in an isometric mineral had been accepted as the cause.

In fine, we can only say of the book to all students of petrography, "get it!"

H. J. JOHNSTON-LAVIS.

THE JOURNAL OF MARINE ZOOLOGY AND MICROSCOPY. Vol. i., no. 1. November 1893 [Quarterly]. 8vo. Jersey and London. Price 2s. per annum, post free, or with 14 Microscopical Studies in Marine Zoology, 21s.

IT is unnecessary to call attention to the beautiful microscopical preparations sent out by the Jersey Biological Station, they speak for themselves; but it will be interesting to many to learn of a new publication, the chief feature of which will be the illustration and explanation of a yearly series of Messrs. Sinel and Hornell's slides. With this first number are sent out three preparations: *Lucernaria*; *Tomopteris*, the pelagic Annelid; and *Salpa mucronata-democratica*. Two plates accompany the descriptions, and though somewhat rough in execution, are amply sufficient for the purpose intended. Mr. Hornell also describes an albino lobster, 14 inches long, taken in St. Aubin's Bay. A list of other albino organisms is given, and a note follows on the colouration of sponges. Some observations on the Octopus are also added, notably information concerning the strength of this mollusc, its food, and the cleansing process of skin-casting from the suckers. The journal consists of 24 pages, the first 14 being devoted to the special notes just enumerated.

THE OUT-DOOR WORLD; OR, THE YOUNG COLLECTOR'S HANDBOOK. By W. Furneaux, F.R.G.S. 8vo. Pp. 411, 18 plates, and 549 figures. London: Longmans & Co., 1893. Price 7s. 6d.

POPULAR books on natural history are so seldom noteworthy for accuracy, that we are glad to draw attention to one that is distinctly above the average. Mr. Furneaux's second title explains the plan adopted, and also accounts for the disproportionate amount of space devoted to certain groups. The volume is divided into three sections: animal life, the vegetable world, and the mineral world; but three hundred pages are devoted to the first section, which is also much the most satisfactory. Butterflies, moths, and birds' eggs are especially well illustrated, the coloured plates being particularly good for so cheap a volume. Certain of the other groups are not so well done, many of the mollusca, for instance, being scarcely recognisable unless one already knows the species. In a second edition, the botanical portion should be revised. The plan has evidently been altered while the proofs were being corrected, for a chapter on grasses is misplaced, and is illustrated by plates out of the numerical order. We would suggest also that in future editions it would be well to draw attention to the importance of noting the exact date, locality, and conditions under which each specimen was obtained. The recording of these facts is an excellent training for the boy, besides adding greatly to the value of his collection.

WE learn that the first part of Mr. C. Davies Sherborn's "Index to the Genera and Species of the Foraminifera" will appear about the end of this year. This index, which is brought down to December, 1889, and which is being published by the Smithsonian Institution, occupied the author over four years, and went to press early in 1890. The second and concluding portion may be expected in 1895.

OBITUARY.

HERMANN AUGUST HAGEN.

BORN MAY 30, 1817. DIED NOVEMBER 11, 1893.

SO long as the study of Insects is continued, so long will the memory of Professor H. A. Hagen be venerated. The author of "Bibliotheca Entomologica; Die Litterature über das ganze Gebiet der Entomologie bis zum Jahre 1862," which appeared in 1862–1863, has done so much to lighten the labours of his fellows, that he will always be remembered with gratitude. Hagen was born in Königsberg in 1817, and practised there, as a Doctor of Medicine, until 1867, when he left Germany for America and became assistant to Louis Agassiz. In 1870 he was appointed to the chair of Entomology at Harvard, a professorship he held till his death. Hagen, though specially interested in the Literature of Entomology, found time to write several hundred papers on Insects themselves, among which may be mentioned a Catalogue of *Termitina* in the British Museum, 1858.

AUGUST KARL EDUARD BALDAMUS.

BORN APRIL 18, 1812. DIED OCTOBER 30, 1893.

THIS well-known ornithologist was born at Giersleben, in Saxony. He studied theology at Berlin, and in 1859 was elected Professor at the Köthen Gymnasium. Here he became acquainted with the brothers Naumann, and profited from their ornithological researches. He was pastor at Dielzig in 1849, and passed, in 1858, to the same office at Osternienburg. After his retirement, in 1870, he lived at Coburg. Baldamus collaborated with Blasius in bringing out Naumann's "Naturgeschichte der Vögel Deutschlands," and wrote "Illustriertes Handbuch der Federviehzucht" (ed. 2, 1881), and "Vogelmärchen," 1882. To his initiative was due the foundation of the German Ornithological Society; while from 1849–1858 he published the journal called *Naumannia*.

GEORGE BENNETT.

BORN, 1803. DIED, OCTOBER 1, 1893.

BORN at Plymouth ninety years ago, George Bennett was educated for the medical profession. Visiting Sydney in 1830, he decided to practise there, but did not finally settle until six years later. A

lifelong friend of Richard Owen, Bennett became an enthusiastic naturalist, and provided his friend with rich and valuable material. The first to find Nautilus in the living state, he forwarded his prize to Owen, who wrote upon it his celebrated "Memoir on the Pearly Nautilus," 1832. Bennett wrote numerous papers on Natural History, the most important perhaps being his observation on *Ornithorhynchus* (*Proc. Zool. Soc.*, 1859); he also published "Wanderings in New South Wales," 1834; and "Gatherings of a Naturalist," 1860. On the foundation of the Australian Museum, Bennett was chosen as first Secretary, and the growth and importance of that Institution is largely due to the energy and industry of this eminent naturalist.

NEWS has been received of the death of Dr. Dionys Stur, the eminent geologist and palæobotanist, who passed away at Vienna on October 9. For more than forty years he was connected with the Imperial Geological Survey of Austria, and in 1885 became Director. He retired from the service in April of last year. In 1890 Dr. Stur received the Cothenius Medal from the Leopold Caroline Academy, and was elected a Foreign Member of the Geological Society of London.

WE also have to record the death, on November 13, of Mr. William Dinning, the well-known Honorary Secretary of the Natural History Society of Northumberland and Durham. He had attained the age of 57, and had been in failing health for some time. Mr. Dinning's chief scientific occupation, pursued in whatever leisure he could obtain in the midst of absorbing business-engagements, was the collection and patient preparation of the vertebrate fossils of the local Carboniferous and Permian formations. He accomplished much in association with the late Messrs. T. P. Barkas and Thomas Atthey, and several of his beautiful drawings illustrate the papers of Messrs. Hancock, Atthey, and Embleton in the *Annals of Natural History* and the Northumberland *Transactions*.

IN our October number (p. 308) we gave a short notice of the late Edward Charlesworth. We were unable at the time to ascertain the dates of his birth and death. We learn (from the *Geological Magazine*) that he was born September 5, 1813, and died July 28, 1893.

NEWS OF UNIVERSITIES, MUSEUMS, AND SOCIETIES.

Dr. Karl von Dalla Torre has been appointed Extraordinary Professor of Botany at the University of Innsbruck.

Dr. A. Grob has been appointed assistant in the Plant Physiological Institute of the Polytechnic at Zurich.

Dr. Achille Terracciano has retired from his position as Conservator of the Royal Botanical Institute at Rome, and Dr. Oswald Kruch has taken his place.

Professor P. Soraner resigned, on October 1st, the superintendence of the plant physiological research station at Proskan, and Dr. Rudolf Aderhold, formerly first assistant in the similar institute at Geisenheim, has been appointed in his stead, while Dr. F. Krüger takes Dr. Aderhold's place.

The Professorship of Geology in the Bohemian University of Prague has been filled by the election of Dr. Woldrich, of Vienna.

Professor Charles Stewart, of the Royal College of Surgeons, has been elected Fullerian Professor of Physiology at the Royal Institution of Great Britain.

The Owen Memorial Committee has entrusted the execution of the statue of the late Sir Richard Owen to Mr. T. Brock, R.A.

Dr. T. Pleske has succeeded the late Dr. Strauch as Director of the Natural History Museum of the Imperial Academy of Sciences, St. Petersburg.

It is proposed to establish a small Biological Station at Millport, for the study of the Marine Zoology of the Firth of Clyde and West of Scotland generally. A temporary station has already existed for some years at the same place, and during 1891–92 the Government Grants' Committee of the Royal Society of London provided £100 for the investigation of the Clyde Sea area. Much valuable work can be done in the district, and contributions to the building-fund of the station are earnestly solicited by the Committee, who have just issued a circular on the subject. The treasurer of the fund is Robert Gourlay, Esq., Bank of Scotland.

On November 8, the Mayor of Carlisle opened a new Institute of Science, Art, and Literature, built by the town corporation at a cost of £20,000. The Museum contains a large collection of local rocks and fossils, antiquities, and birds, besides other natural history specimens.

The Year-Book of the Bergen Museum for 1892 has just come to hand. In it Dr. J. Brunchorst gives, in German, an account of the biological station in Bergen,

and of the machinery by which the aquaria are supplied with air and water. In addition to the official reports of the curators, the volume contains papers by A. Appellöf (on "Cephalopoda of the North Sea"), O. Nordgaard (on "Polyzoa, Echinodermata and Hydroids of Beitstad Fjord"), J. A. Grieg (on "Ophiurids from Greenland"), and J. Brunchorst ("Some Illnesses of Norwegian Timber"), as well as two archæological papers.

BETTER days are dawning for the South African Museum at Cape Town, which is at present "cribbed, cabined and confined" in one wing of the handsome Public Library building. A new Museum is to be erected in the Government Gardens, at a cost of £20,000, and the present rooms handed over to the Library. Let us hope that the working expenses of the Museum will be provided for in a like liberal manner.

IN Hong Kong there is a Museum rather of the Curiosity Shop order; but an energetic literary and scientific local society, known as The Odd Volumes, are taking the matter up. They have had a deputation to the Governor, Sir William Robinson, and a lecture from an official of the British Museum. The Governor is willing, but the Press are not. The old objection is in the way—want of money. We can but wish The Odd Volumes the success they deserve.

WE learn from the *American Naturalist* that some public-spirited citizens of Chicago have formed a corporation for the purpose of creating and sustaining a Museum, which shall furnish to the public of the city an educational exhibition. It is proposed that the Museum shall be located near to Jackson Park and the University, and for the present the California Building of the World's Fair is to be utilised. Professor F. W. Putnam, the distinguished archæologist, has been appointed managing director. The idea is that Professor Putnam will organise the Museum into departments, placing over each a competent head, who will make the institution a medium for original research, as well as for exhibition, as is the case with all the best museums of the world. It will thus become useful, not only to the general public, but to the University and to the Academy of Sciences. This body of scientific experts, connected with the Museum and University, should stir up the Chicago Academy of Sciences, which has laid dormant so many years.

A ROYAL Medal was awarded to Professor Harry Marshall Ward at the Annual Meeting of the Royal Society of London on November 30, in recognition of his researches on the life-history of fungi and schizomycetes. The Copley Medal is this year awarded to the distinguished physicist, Sir George Gabriel Stokes, Bart. The only change in the list of officers of the Society consists in the succession of Sir Joseph Lister to the Foreign Secretaryship, vacated by Sir Archibald Geikie. The new members of Council representing Natural Science are Professor A. H. Green, Sir John Kirk, Sir John Lubbock, and Professor Burdon Sanderson.

THE Zoological Society of London have printed, in their last issue of *Proceedings*, a valuable and important statement of the exact date of issue of their octavo publications. The dates of their quarto publications have long been listed and printed on the covers of the *Transactions*. The information, which shows the number of the issue, the pages contained in each issue, and the date of delivery from the printers, has been supplied to the Society by Messrs. Taylor and Francis, the Society's printers, and will be of assistance in settling vexed questions of priority. We have often wondered why Societies are so shy of printing the date of issue of their publications side by side with the signatures. The example has been set in certain separate publications for many years, *e.g.*, Bronn's "Nomenclator Palæontologicus," and Godman and Salvin's "Biologia Centrali Americana," where the

dates are inserted with painstaking accuracy. Of course, this inserted date must be that of issue, not that of writing the MS., for the latter is an imposition which cannot be too strongly condemned.

THE Cotteswold Naturalists' Field Club have recently published the first part of vol. xi. of their *Proceedings*. An address by the retiring President, Mr. W. C. Lucy, contains some notes on a large boulder found imbedded in quartzose sand on the top of Cleeve Cloud; the force that transported the boulder and sand have also considerably disturbed the Oolitic rocks of the hill. This number also contains an important paper by Mr. R. Etheridge, F.R.S., on the rivers of the Cotteswold Hills within the watershed of the Thames, which discusses their importance as a supply to the main river and to the metropolis. Accompanying the paper is a Hydro-geological map of the Thames Basin above Wallingford and Oxford. The author discusses the practicability of forming reservoirs at various places in the upper basin of the Thames. The number concludes with an account by Professor J. Allen Harker of the experiments that have led to the conclusion that leguminous plants can obtain a supply of nitrogen from the atmosphere by the aid of the symbiotic organisms that form the tubercules on their roots.

A SOCIETY known throughout the country by the results of practical investigations in which it has been so long engaged, the Yorkshire Naturalists' Union, with a total numerical strength of almost 3,000, may be said to occupy a premier position among county scientific institutions. Probably there has never been a gathering more thoroughly representative of the scientific activity of Yorkshire than that which took place in the Town Hall, Skipton, on the 14th ult., the occasion of the Union's thirty-second annual meeting.

The usual sectional meetings were held during the day at the Grammar School, and at these reports of the year's work were received, and officers elected for the ensuing twelve months. Each branch of Natural Science has a president and secretaries, whose duties are to control and direct the work of their own department, and prepare the results for publication in the *Transactions*, which are issued to members and contain a permanent record of all observations.

The business affairs of the Union are in the hands of a permanent General Committee, which met in the afternoon under the presidency of Dr. H. Clifton Sorby, LL.D., F.R.S. Seven committees of research, in connection with the British Association, were again appointed, and amid applause, Mr. W. Denison Roebuck, F.L.S., who has served the Union faithfully for many years, and to whom in main it owes its success, was, for the eighteenth time, elected hon. secretary.

In the evening an exhibition and conversazione, arranged by the Craven Naturalists' Society in honour of the visit of the Union, was held in the Town Hall, and at 7 p.m., when Mr. Henry Seebohm came forward to deliver his presidential address, an audience had assembled which quite overfilled the spacious building. In his opening remarks Mr. Seebohm, who is practically a native of Skipton, said how deeply he felt the honour which his position as President for 1893 gave him. To use his own words—"Little did I think, when a lad catching butterflies and tramping o'er hill and dale for what information I could get of the natural history of the neighbourhood of Skipton, that I should one day occupy the position I do to-night among Yorkshire naturalists." After thanking the Union for the honour they had done him, he proceeded to his address on "The Geographical Distribution of British Birds," of which a printed copy was presented to each member.

On the motion of Dr. Sorby, a vote of thanks was accorded to the President, and the Union is now able to add one more to the long list of distinguished men who have honoured it by their tenure of office.

It was announced that the Presidency for 1894 had been offered to, and accepted by, Mr. R. H. Tiddeman, M.A., F.G.S., of the Geological Survey, and the next annual meeting is to be held at Doncaster.

CORRESPONDENCE.

Emendations of Nomenclature.

In your last number (vol. iii., p. 328) you are severe on those who emend generic or specific names to make them agree with well-known rules of composition and orthography. Certainly anyone would agree with you that "the practice of emending names the etymology of which is not clear to the emendator's mind is a reprehensible one"; but when the etymology is clear, not only to the mind of the emendator, but to all those who have considered the origin of the term, and even to the author himself, is one then to be blamed for spelling a word in such a way that it shall convey to others the original intention of the author? Is an author's ignorance or carelessness to be eternally perpetuated to his own disgrace and to the perplexity of those who vainly try to discover the meaning of his names? Or is scientific nomenclature on a par with nonsense rhymes and the game of Russian scandal, where the essence of the joke depends on its absurdity? Of course, it is not often that a scientist is so unlearned in everything save his own subject as to describe a fossil as made of ivory *(eboreus)*, when he means to convey the really useful information that it occurs near York *(eboracensis)*; but it is unfortunately more often the case that scientists, like other people of humbler pretensions, do drop their "h" s. But since we do not all talk about Mrs. Enry Awkins, is there any reason why we should all talk about *Eleocharis* when we mean *Heleocharis*? Certainly your remarks are hardly consistent with the British Association rules of Zoological Nomenclature, of which number 14 is, "In writing zoological names the rules of Latin orthography must be adhered to." The eminent compilers of that code also say, "In the construction of compound Latin words, there are certain grammatical rules which have been known and acted on for two thousand years, and which a naturalist is bound to acquaint himself with before he tries his skill in coining zoological terms." True that, in the particular instance, you are dealing with Botanical names; but the rules of common-sense should apply equally to both Zoology and Botany. There is nothing that sets the scholar against the natural sciences more than this apparent ignorance of rules known even to me, your old friend,

Macaulay's Schoolboy.

[Our youthful friend forgets that scientific nomenclature is for the use of scientific men, not for those students of Latin and Greek to whom he arrogates the title "scholar." In the opinion of those who deal much with names, universality is at least as important a factor of intelligibility as etymological correctness.—Ed.]

TO CORRESPONDENTS.

All communications for the Editor *to be addressed to the* Editorial Offices, 5 John Street, Bedford Row, London, W.C.

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A Monthly Review of Scientific Progress.

JULY, 1893.

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NATURAL SCIENCE:

A Monthly Review of Scientific Progress.

In addition to Notes and Comments on the progress of Natural Science, brief Reviews of Current Literature, Obituary Notices, and News of Universities, Museums, and Societies, the last three numbers of this Journal comprise the following specially contributed Articles:—

No. 16, June, 1893.

I. Flowers in the Guiana Forest. By James Rodway, F.L.S.
II. Biological Theories. V.—Suggestions as to the True Functions of "Tentaculocysts," "Otocysts," and "Auditory Sacs." By C. Herbert Hurst, Ph.D.
III. Naegeli's Experiments on Living Cells. By Miss A. L. Smith.
IV. Some Extinct Sharks and Ganoid Fishes. By A. Smith Woodward, F.L.S.
V. Notes on Warning and Protective Colour in Lepidopterous Larvæ. By Miss Lilian J. Gould.
VI. Cannibalism among Insects. By Carl Berg, Ph.D.
VII. The Classification of Arachnids. By George H. Carpenter, B.Sc.
VIII. The Great Barrier Reef of Australia.

No. 17, July, 1893.

I. Recent Researches on Plant Nutrition. By J. Percival, M.A., F.C.S.
II. The Respiration of Birds. By F. W. Headley, M.A., F.Z.S.
III. Observations on Certain Marine Animals. By James Hornell.
IV. Recent Progress in Conchology. By B. B. Woodward, F.R.M.S.
V. The Museums of Public Schools. I.—Charterhouse. By Oswald H. Latter, M.A.
VI. The Surface of the Moon. By Professor G. K. Gilbert, Ph.D.
VII. Antarctica: A Supposed Former Southern Continent. By Henry O. Forbes, F.R.G.S.
VIII. On the Work of Glaciers. By Rev. A. Irving, M.A., F.G.S.
IX. Professor Huxley on Evolution and Ethics.

No. 18, August, 1893.

I. Rainfall and the Forms of Leaves. By Miss Annie Lorrain Smith.
II. On the Zoo-Geographical Areas of the World, illustrating the Distribution of Birds. By R. Bowdler Sharpe, LL.D., F.L.S.
III. Earthworms and the Earth's History. By F. E. Beddard, M.A., F.R.S.
IV. Some Useful Methods in Microscopy. By E. A. Minchin, M.A.
V. Recent Additions to our Knowledge of the Eurypterida. By Malcolm Laurie, M.A., F.L.S.
VI. Supposed Fossil Lampreys. By A. Smith Woodward, F.L.S.
VII. The Origin of Monocotyledonous Plants. By A. B. Rendle, M.A., F.L.S.
VIII. The Recapitulation Theory in Biology. By S. S. Buckman, F.G.S.
IX. Professor Blake "On the Bases of the Classification of Ammonites."

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